NON-AUDITORY HEALTH RISKS OF ROAD TRAFFIC NOISE AND COMMUNITY NOISE ANNOYANCE

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Abstract

With respect to cardiovascular diseases the overall evidence suggests that a weak association exists between long-term noise exposure and blood pressure elevation or hypertension. Objectives of the present study were to evaluate the influence of road traffic noise on some non-auditory health effects indicators (annoyance, systolic, diastolic blood pressures, cardiovascular risk score), to investigate the associations among them and to calculate some non auditory health effects risks (odds ratio, 95% CI) of road traffic noise. The results of our study confirmed significantly higher risks for road traffic noise annoyance and interference with various activities in the exposed group. Bivariate analysis comparing exposed and control group showed higher, although not significant risks for the group exposed to road traffic noise in terms of systolic blood pressure level and diastolic blood pressure level. Multiple linear regression revealed association between the level of road traffic noise annoyance and diastolic blood pressure. Our results show that the level of noise annoyance as well as noise sensitivity could be the important factors in these types of studies, even in less homogenous samples.

Introduction

Non-auditory health effects of noise are the result of stimulation of vegetative nervous system, reticular formation, cortical and subcortical brain centers. Noise acts as a stressor activating the mechanisms of stress reactions in the organism. Hypertension, ischaemic heart disease, annoyance and sleep disturbance are often discussed in scientific literature. With respect to cardiovascular diseases the overall evidence suggests that a weak association exists between long-term noise exposure and blood pressure elevation or hypertension.

Noise annoyance is a global phenomenon. A definition of annoyance is "a feeling of displeasure associated with any agent or condition, known or believed by an individual or group to adversely affect them" (1, 2, 3, 4, 5). However, apart from annoyance people may feel a variety of negative emotions when exposed to community noise and may report anger, disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety or exhaustion. The term annoyance does not cover all the negative reactions, but it is often used for convenience in community noise studies as well as in Guidelines for Community Noise, WHO (5)

Objectives of the present study were to evaluate the influence of road traffic noise on some non-auditory health effects indicators (annoyance, systolic, diastolic blood pressures, cardiovascular risk score), to investigate the associations among them and to calculate some non auditory health effects risks (odds ratio, 95% CI) of road traffic noise.

Methods

Our sample (n=465; 39.6% males, 60.4% females, mean age 22.3 ± 2) included the exposed group to road traffic noise (n=220, L_{Aeq} =67±2dB) and control group (n=245, L_{Aeq} =58.7±6dB) as well as the groups according several levels of road traffic noise annoyance for each group and for the whole sample.

Equivalent noise levels were assessed at the dormitory (exposed group) and in the residential areas where the other students lived (control group) by Brűel-Kjaer measuring technique. Measuring stations were situated 2 meters from the building facades.

Subjective response of students was assessed by a validated noise annoyance questionnaire developed by Institute of Hygiene, Faculty of Medicine, Comenius University, Bratislava and Institute of Preventive and Clinical Medicine, Bratislava (6, 7, 8). In addition to questions concerning personal and dwelling characteristics it contained questions about possible psychosocial noise effects (annoyance verbal scale, interference with various activities). Questionnaire was administered personally, students were interviewed during practical training by a trained personnel.

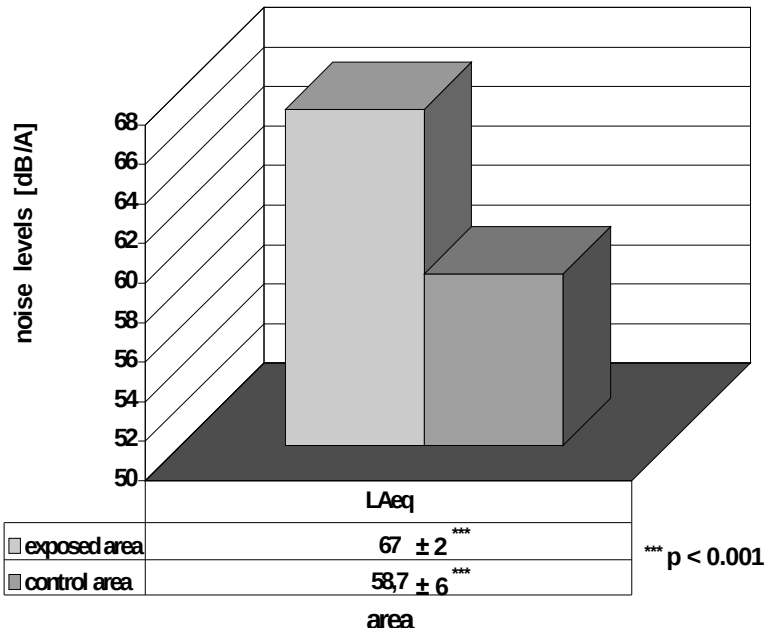
Diastolic and systolic blood pressures (BP) were assessed by a standard method and cardiovascular risk score was calculated. The criteria for normal blood pressure and cardiovascular risk score were established with regard to relatively low age of our sample (systolic BP<=120 mmHg, diastolic BP<=80 mmHg, cardiovascular risk score<=30).

Noise annoyance and other non-auditory health effects risks were obtained by bivariate and stratified analysis. Major tools in our statistical analysis were EPI Info 6.04, Statcalc, EPI Info 2000 and S-Plus 4.5.

Results

Equivalent noise levels have reached 67±2 versus 58.7±6dB/A (exposed versus control area) (Figure 1).

Figure 1: Noise levels in the observed areas



Students in the exposed group were significantly more annoyed by road traffic noise (OR_{MH} = 5.51, 95% CI=4.21-7.88) and their risks of interference with various activities were significantly higher. Bivariate analysis comparing exposed and control group showed higher, although not significant risks for the group exposed to road traffic noise in terms of systolic blood pressure level (OR = 1.12; 95% CI = 0.71 - 1.77) and diastolic blood pressure level (OR = 1.31; 95% CI = 0.68 - 2.53) (Table 1).

Road traffic noise annoyance was assessed subjectively in three grade scale (not annoyed, annoyed a little, annoyed). The number of respondents annoyed by road traffic noise was significantly higher in the exposed group and vice versa (Table 2).

Table 1: Risks of some non-auditory health effects of road traffic noise (exposed versus control group)

Indicator	OR (95 % CI)	chi-square	p-value
Systolic blood pressure level (>120 mm Hg)	1.12 (0.71-1.77)	0.27	0.6
Diastolic blood pressure level (>80 mmHg)	1.31 (0.68-2.53)	0.72	0.4
Cardiovasc. risk score (>30)	1.05 (0.71-1.55)	0.05	0.8
Psychogenic stress	0.93 (0.63-1.37)	0.16	0.7
Noise annoyance	+ 5.51 (4.21-7.88)***	137.9	< 0.001
Nervousness and irritability	0.94 (0.61-1.46)	0.08	0.8

*** statistically very highly significant
+ Mantel-Haenszel weighted odds ratio

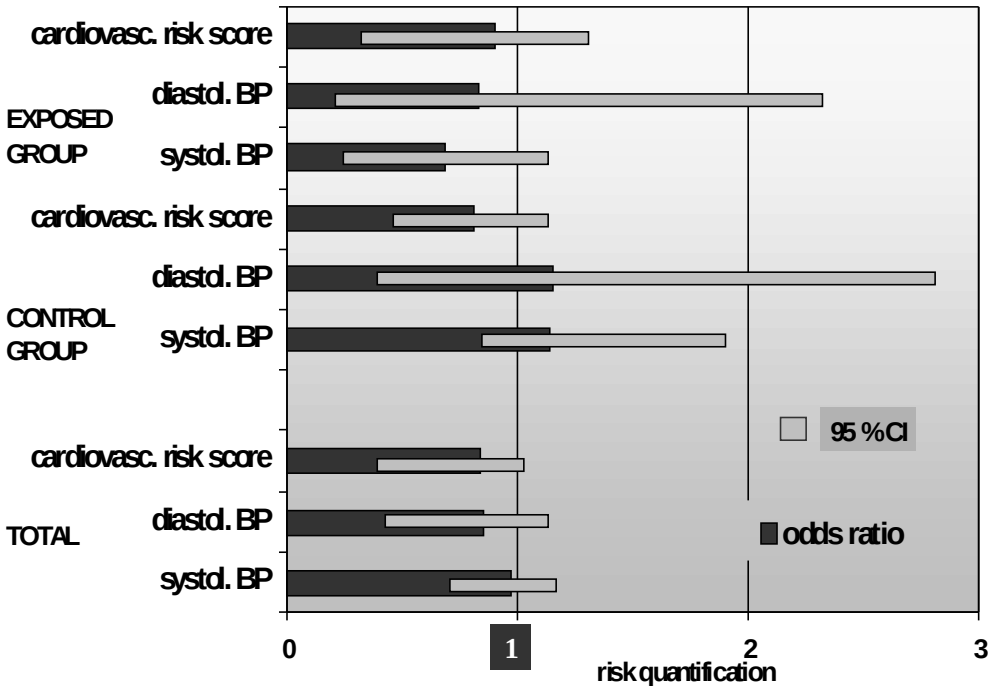
Table 2: The level of noise annoyance (exposed versus control group)

The grade of road traffic noise annoyance	Exposed (n=220) (100%)	Unexposed (n=245) (100%)	Total (n=465) (100%)	Summary odds ratio (95 % CI)	Summary chi-square (M-H)
Not annoyed	20 (9.1%)	107 (43.7%)	127 (27.3%)		
Annoyed a little	75 (34.1%)	93 (38%)	168 (36.1%)	5.52 (4.21-7.89)	138.17
Annoyed	125 (56.8%)	45 (18.3%)	170 (36.6%)		

p < 0.001

M-H = Mantel-Haenszel
CI= confidence interval

Figure 2: Risks of blood pressure and cardiovascular risk score elevation influenced by road traffic noise annoyance



Stratified analysis for noise annoyance has been done in the exposed, not exposed group and in the total sample. Marginal, not significant association between noise annoyance in the total sample (OR_{MH} =0.85 (95% CI= 0.54-1.34) for diastolic blood pressure and for cardiovascular risk score (OR_{MH} =0.84 (95% CI= 0.63-1.10) has been shown. An association has been indicated in the exposed sample between noise annoyance and systolic blood pressure (OR_{MH} =0.73 (95% CI= 0.41-1.16) (Figure 2). Multiple linear regression revealed association between the level of road traffic noise annoyance and diastolic blood pressure (r^2 = 0.46, b = - 1.231, F = 4.4, p = 0.04). Important confounding factors such as smoking, gender and BMI (body mass index) were also taken into account.

Discussion

In our study we were following the association among subjective evaluation of noise exposure and non-auditory, non-specific effects of road traffic noise in the sample of university students. The noise exposure was subjectively evaluated according to the level of noise annoyance and interference with various activities. The level of noise annoyance as the most general response of the population to exceeded acceptable noise levels was investigated in relation to systolic and diastolic blood pressure levels elevations as well as to cardiovascular risk score.

In recent publications noise annoyance as well as noise sensitivity is used as an important factor in community noise studies. Some associations show that the level of noise annoyance could be an indicator of noise exposure in relation to non-auditory health effects (especially in the cardiovascular system) (9, 10). At the work place, Lercher (1993), found out with the help of multivariate analysis the effect of noise annoyance on systolic and diastolic blood pressure levels in mmHg (9). The elevation for systolic blood pressure was as mean difference 2.1 (95 % CI =(-3.0 - 7.3)) and for diastolic blood pressure 3.5 (95 % CI= (0.3-7.4)). The level of subjective annoyance evaluation as the noise exposure indicator was used in the environment (11). The result was in contradiction with the expected association (the highest percentage of probands with hypertension was in the group with the lowest subjective annoyance by road traffic noise). The more careful psychological analysis is needed in this case.

It is important to coordinate and standardize survey questions in different countries. After 7 years of discussions and research the team has developed and tested a method that attempts to meet these goals and recommends the use of a pair of multi-purpose questions in five grade scale (1, 12). In our study three degree scale was used and we have to take this into account when comparing results with other surveys.

In our study bivariate analysis showed some indicated (not significant) risks of diastolic and systolic BP levels elevation in the exposed group and significant road traffic noise annoyance risks for various activities in the exposed group. Stratified analysis for noise annoyance levels showed marginal, negative, not significant association between noise annoyance and diastolic blood pressure and cardiovascular risk score. Marginal, negative association was found between noise annoyance levels and systolic blood pressure level. Multiple linear regression revealed negative association between road traffic noise annoyance and diastolic blood pressure level taking into account important confounding factors (gender, BMI, life style). These results are consistent with Lercher, 2000 (11).

Conclusion

Our study confirmed significantly higher risks for road traffic noise annoyance and interference with various activities in the exposed group. Some association between diastolic blood pressure and road traffic noise exposure was also found. However, the level of noise annoyance as well as noise sensitivity could be the important factors in these types of studies, even in less homogenous samples.

Our results show that health effects of road traffic noise are considered to be an important problem requiring a multidisciplinary team of experts.

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