

## ENVIRONMENTAL NOISE AND MENTAL DISTURBANCES IN URBAN POPULATION

Ljiljana Stošić<sup>1</sup> and Ljiljana Blagojević<sup>2</sup>

The aim of this study was to assess the relationship between the presence of environmental noise and frequency of mental disturbances in adults. The study included 911 subjects living in the city of Niš, aged from 18 to 80 years. A questionnaire containing questions related to the psychological problems of examinees was administered. Also, the levels of noise in the streets in which the study population lives were assessed. Based on the intensity of noise, city locations were divided into the noisy (daily period  $Leq \geq 55$  dBA and night  $Leq \geq 45$  dBA) and quiet (daily period  $Leq \leq 55$  dBA and night  $Leq \leq 45$  dBA). Our data showed that environmental noise had negative influence on the exposed adults. Subjects living in the noisy locations reported to feel depressed ( $\chi^2=8,75$ ,  $p=0,03$ ) and nervous ( $\chi^2=12,43$ ,  $p=0,006$ ) more frequently than those living in the quiet parts of the city. Also, the subjects living in the noisy locations referred to psychologists or psychiatrists more frequently than the subjects living in the quiet parts of the city ( $p=0,04$ ). *Acta Medica Medianae* 2011;50(3):34-39.

**Key words:** environmental noise, urban environment, mental disturbances, neurovegetative disorders

Public Health Institute Niš, Serbia<sup>1</sup>  
University of Niš, Faculty of Occupational Safety, Serbia<sup>2</sup>

Contact: Ljiljana Stošić  
Public Health Institute Niš  
Bul. dr Zorana Đinđića 50, 18000 Niš, Serbia  
E-mail: ljstosic@live.com

### Introduction

Community noise has become one of the most important environmental and public health problems, especially in developed countries (1).

According to the estimates of the European Environment Agency, about 210 million people in the European Union, more than 44% of the population is exposed to traffic noise levels above 55 dBA, and more than 50 million people are exposed to noise levels above 65 dBA during the 24 hours that are referred to as "black" acoustic point (2).

Community noise has a large range of negative effects on the health of the exposed population. It impairs the quality of life due to the disruption of daily activities, concentration, communication, rest and sleep (3, 4). Long-term effects of noise, due to permanent stimulation of the sympathetic nervous system may lead to more frequent occurrence of cardiovascular disease (5, 6). Indirectly, noise affects various aspects of behavior.

Noise can cause an unpleasant feeling, bad mood, frustration and sleep disturbance that may lead in the case of prolonged exposure to the onset or to the intensification of mental disorders.

In order to study the negative effects of noise on mental health, the assessment of different

symptoms of mental and behavioural disorders (instability, frequent changes of mood, headache, increase of social conflicts, anxiety, emotional disturbances, increase of neurosis, psychosis) is usually performed.

The aim of our study was to assess the influence of environmental noise on the occurrence of mental health disturbances in Serbian adults.

### Subjects and methods

This study was designed as a cross-sectional survey performed among the residents of the centre of the city of Niš.

Study population was chosen from three city municipalities in which the systematic measurement of environmental noise was performed: municipality of Medijana, municipality of Pantelejš and municipality of Niška Banja.

In order to select the study population, we took the poll lists and then selected all the residents living in the streets in which the measurement of noise was performed and also all residents living in the streets located nearby, up to 500 m of distance. At that point, we selected each fifth name from the list, using the method of step sampling and then administered the questionnaires to the study subjects chosen in this way. The examinees were asked to complete the questionnaires by the next day.

Inclusion criteria in the study were age between 18 and 80 years and at least one year of living at the examined location. Exclusion criteria were exposure to noise at the working place and loss of hearing.

The questionnaires were being administered from December 2007 to March 2008. Out of 3.000

distributed questionnaires, 1.063 ones were completed (35.4%). After applying the exclusion criteria, the final study population involved 911 subjects.

We utilised the original questionnaire, adapted to the local conditions and requests, created on the base of the questionnaire already utilized in similar studies. The first part of the questionnaire contained demographic data (age, sex, educational level, economic status and employment). In the second part of the questionnaire, the participants were asked about the psychological symptoms that could be associated with noise exposure (feeling depressed, nervous, use of analgesics and sedatives), about the frequency of their occurrence („rarely of never“, „once a week“, „more than once a week“, „every day“) and about the frequency of referring to psychologists or psychiatrists („never“, „rarely“, „sometimes“ and „regularly“).

In order to exclude professional exposure to noise, we utilised four-degree scale of occupational exposure („not exposed“, „yes, but noise does not disturb me“, „yes, noise disturbs me“ and „yes, I have a hearing damage“).

Equivalent noise levels (Leq) were used as indicators of the exposure of study population to noise. Leq is defined as equivalent steady noise level containing the same noise energy as the time-varying noise during the same time period. Lday represents the exposure to the mean equivalent level of noise during the day time, from 07h till 22h. Lnight represents the exposure to the mean equivalent level of noise during the night time from 22h till 07h.

Measurements of the environmental noise was performed by the Faculty of Occupational Safety in Niš, using a Brüel & Kjær noise level analyzer type 4426 in accordance with Serbian and ISO Noise Regulations. Sampling was performed during three daily intervals (9.00h-12.00h, 13.00h-16.00h, 17.00h-20.00h,) and two night intervals

(22.00h-1.00h, 2.00h-5.00h) in order to determine the equivalent noise levels referred to the measuring time of fifteen minutes.

The measurements were performed from May 2007 till April 2008.

### Statistical analysis

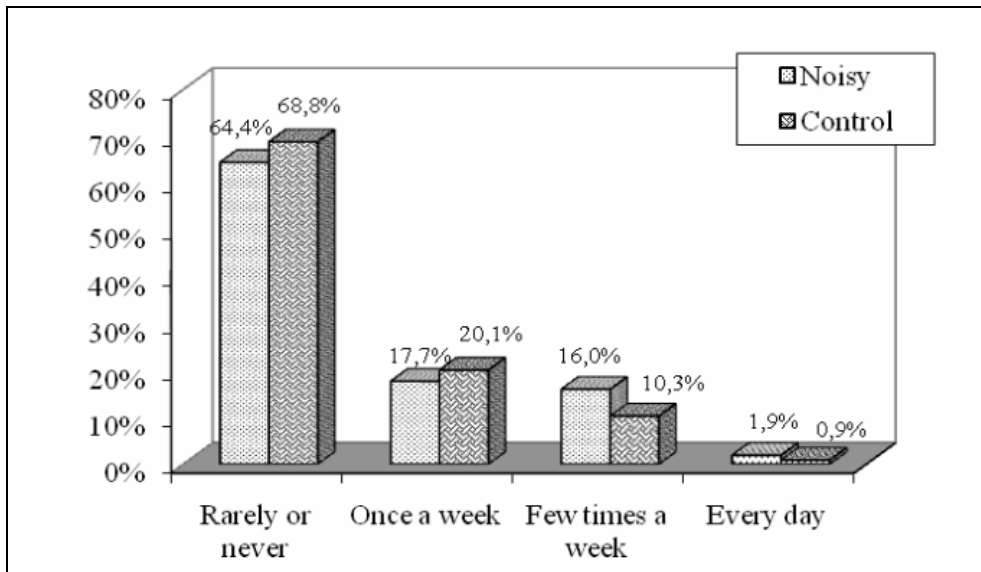
We used the Student's t-test for comparison of means of numeric variables with normal distribution in two independent samples. Differences in distribution of categorical variables in two independent samples were tested with Pearson chi square test, using the Yates correction. A probability of error of less than 5% ( $p < 0.05$ ) was accepted as significant. All statistical analyses were performed using SPSS (version 10.0) and Statcalc from EPI-INFO (version 6) statistical computer programs.

### Results

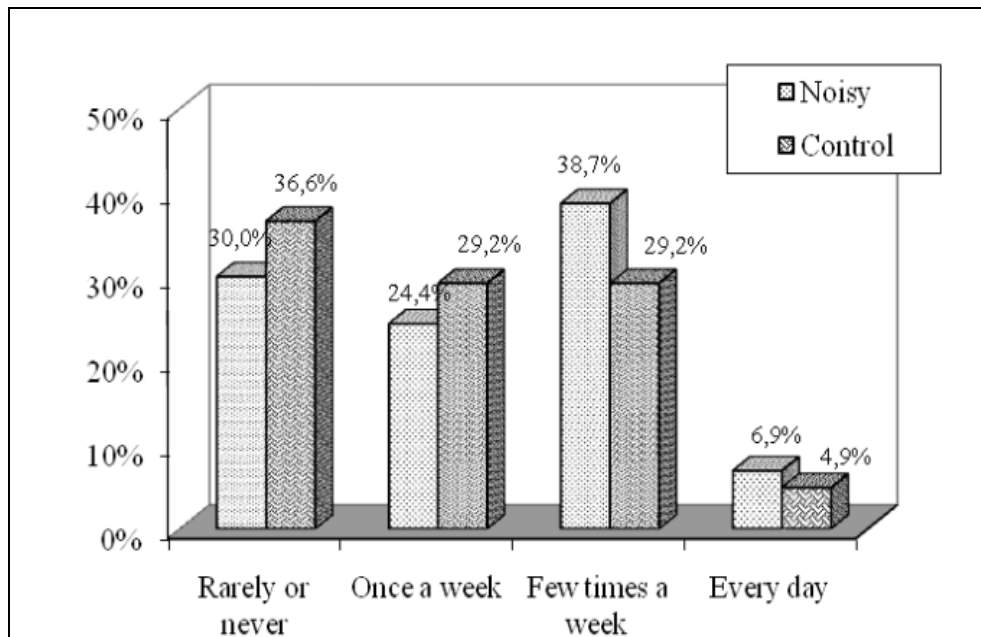
The measurement of environmental noise showed that the levels of daily noise in all investigated locations of municipality of Mediana were higher than 55 dBA. At the same locations, the level of noise during the night was higher than 45 dBA (Table 1). In the locations situated in the municipalities of Niška Banja and Pantelej, the levels of the environmental noise were much lower, ranging from 47 dBA do 51 dBA during the day and from 39 dBA to 45 dBA during the night. Since the streets with day Leq > 55 dB and night Leq > 45 dB are considered noisy according to WHO recommendations and those with day Leq < 55 dB and night Leq ≤ 45 dB are considered quiet, in accordance with the Serbian regulation on noise limits in residential areas, we characterized the municipality of Medijana as noisy and the municipalities of Niška Banja and Pantelej as quiet.

Table 1. Environmental noise at different city locations

Municipality	Location	Noise levels (dBA)	
		Day period	Night period
Medijana (Noisy)	„Božidar Adžija“	64	58
	Byzantine Avenue	64	58
	„Medijana“	63	60
	Puppet theatre	62	59
	Residential building across the street of the Clinical Center	62	58
	„Sava Surgery“	67	60
	Primary school „Vožd Karađorđe“	68	64
	Park on the square Sindelić	63	58
	Specialized school „Filip Kljajić“	66	60
Niška Banja and Pantelej (Control)	Primary school „Ivan Goran Kovačić“	47	39
	The space between hotels Ozren and Partizan	51	45
	Mavrovska Street below church St. Pantelejmon	51	45



Graph 1. Frequency of feeling depressed



Graph 2. Frequency of feeling nervous

Table 2. Distribution of the study population according to sex

Sex	Location		Total
	Noisy	Control	
Male	204 (44.1%)	184 (41.1%)	388 (42.6%)
Female	259 (55.9%)	264 (58.9%)	523 (57.4%)

Pearson Chi-square test:  $\chi^2=0.83$ ,  $p=0.36$

Table 3. Distribution of study population according to age

Parameter	Location		Total
	Noisy	Control	
Xsr ± SD	45.0 ± 16.3	41.7 ± 13.6	43.4 ± 15.1
Median	42.0	40.0	41.0
Min-Max	20.0 - 87.0	20.0 - 82.0	20.0 - 87.0

Student t test:  $t=3.31$ ,  $p=0.001$

The study population consisted of 911 subjects: 463 living in the municipality of Medijana and 448 living in the municipalities of Pantelej and Niška Banja; 388 men and 523 women (Table 2). The subjects living in noisy locations were considered as exposed population, while those living in quiet locations were considered as control population.

The mean age in the exposed population was 3,3 years higher than the age in the control population and the difference was statistically significant (Table 3).

Subjects living in the noisy locations reported to feel depressed more frequently than the control subjects ( $\chi^2=8,75$ ,  $p=0,03$ ) (Graph 1). Residents in the noisy locations reported to feel nervous more frequently than those living in the quiet parts of the city ( $\chi^2=12,43$ ,  $p=0,006$ ) (Graph 2).

Table 4. Frequency of headache

Frequency	Location		Total
	Noisy	Control	
Rarely or never	280 (60.5%)	295 (65.8%)	575 (63.1%)
Once a week	127 (27.4%)	98 (21.9%)	225 (24.7%)
Few times a week or every day	56 (12.1%)	55 (12.2%)	111 (12.2%)

Pearson Chi-square test:  $\chi^2=3.89$ ,  $p=0.14$

Table 5. Distribution of study population according to frequency of analgesics use

Frequency	Location		Total
	Noisy	Control	
Rarely or never	323 (69.8%)	334 (74.7%)	657 (72.2%)
Once a week	94 (20.3%)	74 (16.6%)	168 (18.5%)
More than once a week	42 (9.1%)	36 (8.1%)	78 (8.6%)
Every day	4 (0.9%)	3 (0.7%)	7 (0.8%)

Pearson Chi-square test:  $\chi^2=2.89$ ,  $p=0.41$

Table 6. Distribution of study population according to frequency of anxiolytics use

Frequency	Location		Total
	Noisy	Control	
Rarely or never	323 (69.8%)	334 (74.7%)	657 (72.2%)
Once a week	94 (20.3%)	74 (16.6%)	168 (18.5%)
More than once a week	42 (9.1%)	36 (8.1%)	78 (8.6%)
Every day	4 (0.9%)	3 (0.7%)	7 (0.8%)

Pearson Chi-square test:  $\chi^2=5.98$ ,  $p=0.11$

Table 7. Distribution of study population according to frequency of referral to psychologists or psychiatrists

Psychologist or psychiatrist's help	Location		Total
	Noisy	Control	
Yes	84 (18.1%)	59 (13.2%)	143 (15.7%)
No	379 (81.9%)	389 (86.8%)	768 (84.3%)

Pearson Chi-square test:  $\chi^2=4.25$ ,  $p=0.04$

There was no difference in the occurrence of headache in the subjects living in the noisy locations compared to control subjects (Table 4).

The use of analgesics and anxiolytics was similar in the residents in the noisy streets and in those living in the quiet locations (Tables 5 and 6).

However, the subjects living in the noisy locations referred to psychologists or psychiatrists more frequently than the subjects living in the quiet parts of the city ( $p=0,04$ ) (Table 7).

## Discussion

Compared to the large number of epidemiological studies (7-11) that followed the impact of community noise on sleep disorders, behaviors and increase in blood pressure, there are few studies that followed the impact of community noise on the appearance of interference in the field of mental health in the exposed population. Previous studies in this field that mainly monitor the impact of aircraft noise have shown that noise affects the occurrence of psychological disorders.

The results of this study show that high percentage of the population of Niš is exposed day and night to the noise levels that are higher than the national limit and recommendations of

the World Health Organization. High noise levels had a negative impact on mental health of urban populations. It has been established that depressed mood and anxiety were more frequent in patients in the noisy area.

The results of the study performed in the 80s in the west London reported the increased prevalence of depression in subjects living in the areas with high levels of aircraft noise (12). The study on Sardinian population (Italy) reported an increased prevalence of anxiety syndromes in subjects exposed to aircraft noise (13). In a survey conducted by Smith with a group of authors (14), a statistically significant association between noise exposure and depression was recorded. The results of research carried out near a Belgian airport showed that exposure to noise levels higher than 95 dBA were associated with increased frequency of depression ( $p<0.001$ ), insomnia ( $p=0.001$ ), unexplained pain in the muscles ( $p<0.001$ ), anxiety, nervousness and irritability ( $p<0.001$ ) (15).

Our study did not show that subjects living in the noisy city locations complained of headache more frequently than those living in the quiet areas. In addition, the exposed subjects did not report to feel tired, without physical efforts, more frequently than control population.

Some similar studies have obtained different results. The exposition to a road noise over 65 dBA was related to an increased occurrence of headache and tiredness in inhabitants of Belgrade (8).

Although some earlier studies (16) have shown that the consumption of drugs such as analgesics and sedatives can be a good indicator of the degree of psychological disturbance in exposed population, in our study, no statistically significant differences in the consumption of these drugs were shown. Probably one of the reasons was that the frequency of headache was not significantly different.

In our study population, subjects living in the noisy locations were referred to psychologists or psychiatrists more frequently than the subjects living in the quiet parts of the city. There are only a few studies on the influence of noise on frequency of admission of patients into psychiatric hospitals,

and on the frequency of referring to specialist. Another study performed at the beginning of the 90s reported a positive correlation between the level of aircraft noise and a number of admissions in two psychiatric hospitals. However, this study also showed that other psychosocial factors influenced psychiatric hospitalization more significantly than noise (17).

### Conclusion

Since the mental health may be influenced by a large number of individual (internal) and external factors, the cause-effect relationship between noise exposure and mental disturbances is still uncertain. However, we can affirm that the long-term exposure to noise and to other stressing factors may lead to the mental health disturbances in the exposed population.

### References

1. Kujala T, Brattico E. Detrimental noise effects on brain's speech functions. *Biol Psychol.* 2009 ;81:135-43. [[CrossRef](#)] [[PubMed](#)]
2. Den Boer LC, Schrotten A. Traffic noise reduction in Europe. Health effects, social costs and technical and policy options to reduce road and rail traffic noise. The Netherlands: CE Delft; 2007.
3. Stansfeld SA, Berglund B, Clark C, Lopez-Barrio I, Fiscer P et al. Aircraft and road traffic noise and children's cognition and health: a cross-national study. *Lancet.* 2005; 365:1942-9. [[CrossRef](#)]
4. Björk J, Ardö J, Strohm E, Lövkvist H, Ostergren PO, Albin M. Road traffic noise in southern Sweden and its relation to annoyance, disturbance of daily activities and health. *Scand J Work Environ Health.* 2006 ;32:392-401. [[PubMed](#)]
5. Belojević G. Komunalna buka i zdravlje: stanje u svetu i perspektive. *Ecologica.* 2000 ; (7):34-8.
6. Babisch W. Transportation noise and cardiovascular risk: Updated Review and synthesis of epidemiological studies indicate that the evidence has increased. *Noise Health.* 2006 ; 30:1-29. [[CrossRef](#)] [[PubMed](#)]
7. Niemann H, Maschke C. WHO LARES Final report Noise effects and morbidity. Berlin center of public health; 2004.
8. Jakovljević B, Belojević G, Paunović K, Stojanov V. Road traffic noise and sleep disturbances in an urban population: cross-sectional study. *Croat Med J.* 2006 ;47:125-33. [[PubMed](#)]
9. Miedema HM, Vos H. Associations between self-reported sleep disturbances and environmental noise based on reanalyses of pooled data from 24 studies. *Behav Sleep Med.* 2007 ;5:1-20. [[CrossRef](#)] [[PubMed](#)]
10. Muzet A. Environmental noise, sleep and health. *Sleep Med Rev.* 2007 ;11:135-42. [[CrossRef](#)] [[PubMed](#)]
11. Michaud DS, Keith SE, Mc Murchy D. Noise annoyance in Canada. *Noise Health.* 2005 ; 7:39-47. [[CrossRef](#)] [[PubMed](#)]
12. Tarnopolsky A, Morton-Williams J. Aircraft noise and prevalence of psychiatric disorders, Research Report. Social and Community Planning Research. 35 Northampton Square, London: EC1; 1980.
13. Hardoy MC, Carta MG, Marci AR, Carbone F, Cadedu M, et al. Exposure to aircraft noise and risk of psychiatric disorders: the Elmas survey. *Soc Psychiatry and Psychiatr Epidemiol.* 2005 Jan;40(1):24-6. [[CrossRef](#)] [[PubMed](#)]
14. Smith AP, Rich N. Helicopter noise, noise sensitivity, annoyance and cardiovascular response. *Inter-Noise 2002, Dearborn, MI, August 19-21.* 2002.
15. Devroey D, Betz W, Coigniez P. Influence of noise on the patients, health perception: An epidemiological registration. *Tijdschrift voor Geneeskunde.* 2002 ;58(21):1392-7.
16. Franssen EA, van Wiechen CM, Nagelkerke NJ, Lebrecht E. Aircraft noise around a large international airport and its impact on general health and medication use. *Occup Environ Med.* 2004 ;61:405-13. [[CrossRef](#)] [[PubMed](#)]
17. Kryter KD. Aircraft noise and social factors in psychiatric hospital admission rates: A re-examination of some data. *Psychological Medicine.* 1990 ;20:395-411. [[CrossRef](#)]

## KOMUNALNA BUKA I MENTALNI POREMEĆAJI KOD URBANE POPULACIJE

Ljiljana Stošić i Ljiljana Blagojević

Cilj rada bio je da se ispita uticaj komunalne buke na učestalost mentalnih poremećaja kod odraslih osoba. Istraživanjem je bilo obuhvaćeno 911 ispitanika grada Niša, starosti između 18 i 80 godina. Korišćen je upitnik koji je sadržao pitanja koja su se odnosila na psihološke smetnje ispitanika. Na osnovu rezultata merenja nivoa komunalne buke određeni su lokaliteti sa visokim nivoima buke (za dnevni nivo  $Leq \geq 55$  dBA i noćni  $Leq \geq 45$  dBA) i lokaliteti sa nižim nivoima buke (dnevni nivo  $Leq \leq 55$  dBA i noćni  $Leq \leq 45$  dBA). Utvrđeno je da komunalna buka negativno psihološki utiče na izložene odrasle osobe. Depresivno raspoloženje se češće javljalo kod ispitanika koji su živeli u bučnoj zoni nego kod ispitanika koji su živeli u kontrolnoj zoni ( $\chi^2=8,75$  i  $p=0,03$ ). Stanovnici bučne zone statistički značajno češće ( $\chi^2=12,43$  i  $p=0,006$ ) su se žalili na nervozu u odnosu na stanovnike kontrolne zone. U pogledu obraćanja za pomoć psihijatru ili psihologu utvrđeno je da ispitanici koji žive u bučnoj zoni statistički značajno češće ( $p=0,04$ ) traže ovu vrstu pomoći nego ispitanici koji žive u tihim delovima grada. *Acta Medica Medianae 2011;50(3):34-39.*

**Ključne reči:** urbana sredina, komunalna buka, mentalni poremećaji, neurovegetativni poremećaji