EVALUATION OF ENVIRONMENTAL NOISE EXPOSURE AND NOISE EFFECTS IN POPULATION OF KUMANOVO, MACEDONIA

Mimoza Velickovski[1], ***Bedri Veliu***[1,] Radmila Maksimovska-Simonovska[1], Gordana Ristovska[2]
[1]Public Health Center Kumanovo, Kumanovo, the Republic of Macedonia
[2]Institute of public health of the Republic of Macedonia, Skopje, The Republic of Macedonia
Autor corespondent: ***Mimoza Velickovski****: mimozapopovska@yahoo.com*

Abstract:
Article is a retrospective study based by a questionnaire survey for quantifying annoyance and the sleep disturbance level within the adult population. The conclusion of the study is that population in Kumanovo who live and work in trade-business-residential and residential areas were exposed to increased noise level and they reported annoyance and sleep disturbance

Key-words: environment, noise, Macedonia

Background.

In the Republic of Macedonia, the legislation to protect against environmental noise is based on the Law on noise protection that is fully harmonized with the European legislation and applies to the residential noise management. Also, were prepared and adopted some by-laws for the limits on noise level requirements, selection of the locations of the measuring points and indicators of exposure to the noise. This created conditions for exposure assessment, monitoring f the noise, creation of noise maps, determination of the population exposed to increased levels of noise and estimation of the effects of noise exposure on the population. The Ministry of Environment and Physical Planning is the authority responsible for collecting data on the noise exposure indicators and the percentage of the population exposed to the noise while the Ministry of Health is responsible for the assessment of noise-induced health effects.

Annoyance, sleep disturbance and cognitive and cardiovascular effects have been identified as the main consequences of chronic noise exposure. Both, the sleep disturbance and annoyance, mostly related to the road traffic noise, comprise the main burdens of environmental noise in Western Europe. Exposure assessments relating to the first round of noise mapping suggest that around 40 million people across the EU are exposed to noise above 50 dB from roads within agglomerations during the night, and more than 25 million people are exposed to noise at the same level from major roads outside agglomerations. It is estimated that DALYs lost (disability-adjusted life year) from environmental noise in the EU countries are 60 000 years for ischaemic heart disease, 45 000 years for cognitive impairment of children, 903 000 years for sleep disturbance, 21 000 years for tinnitus and 654 000 years for annoyance [1].

In Macedonia so far, the strategic noise maps have not been yet prepared, so there are no data about the population exposed to noise and there is no public information about the current status of such exposure [2].

Annoyance due to the environmental noise can be included in estimates of the burden related to the environmental noise when the noise exposure of the population is known and the exposure–response relations are available for estimating the annoyance on the basis of the exposures. However, a direct estimates of annoyance prevalence through an annoyance survey in the population concerned (outcome-based approach) is also possible.

Factors, such as noise source, exposure level and time of day of exposure, only partially determine individual annoyance responses [3]. Noise annoyance during the night-time increases the total noise annoyance expressed by people in the following 24 hours. Various studies have also shown that people living in areas exposed to night-time noise have an increased use of sedatives or sleeping pills [4]. There is little information on actual night noise

exposure and it's subsequent effects as sleep disturbance on the exposed population.

The relation between the effects and Lnight, outside is, however, not straightforward. Short-term effects are mainly related to maximum levels per event inside the bedroom: LAmax, inside. [5].

The Institute of Public Health of Macedonia has developed methods for assessing noise annoyance and sleep disturbance and has carried out a cross-sectional study of adverse health effects in Skopje [6].

The cardiovascular effects of noise have evoked growing interest in recent years. There is now sufficient evidence that the noise affects cardiovascular health. High blood pressure and ischaemic heart diseases (IHD) (including myocardial infarction) show a high prevalence in industrialized countries, where they represent a major cause of death [1].

The immediate effects of exposure to noise, anxiety and sleep disturbances, or their expression in the exposed population, are thought to participate as mediators in the genesis of hypertension and myocardial infarction [6].

The Former Yugoslav Republic of Macedonia is a landlocked country located in the central Balkan Peninsula in south-eastern Europe. The total area is 25 713 km^2, and the estimated population is 2 061 315 with a density of 82.2 per km^2. The capital is Skopje, with 506 926 inhabitants according to the 2002 census. The second largest city is Kumanovo, with 105000 citizens, then Bitola with 95000 inhabitants [7].

Material and methods:

This is a retrospective study on the data from noise measurements for the period 2007-2013 year in Kumanovo. There are 10 noise measurements point, 5 located in trade-business -residential area and the other 5 in residential area (living area). Within the 2007-2010 period the measurements were done once a day resulting in a daily equivalent level of noise but from 2011 to 2013 noise measurements were carried out four times a day at: 10, 13 19 and 23 hours as it is recommended by the Low. Consequently, the equivalent levels of noise might be shown as morning, day, evening, night and a combination of them or as a total (daily) equivalent level of noise.

Questionnaire based survey quantifying annoyance and the sleep disturbance level within the adult population was performed in 2012/13. For assessing the noise effects on the population, a representative sample from adult population consisting of 131 residents was chosen. The effects of community noise were evaluated by assessing the extent of annoyance and sleep disturbance as low, moderator high among exposed individuals. In parallel, the Weinstein scale test for subjective sensitivity to noise was also carried out on the same representative sample.

Results

The results of noise measurements from 2007 to 2013 in trade-businesses -residential area have shown that the average daily noise level was in the range from Leq 65.5 dBA in 2010 to 71.8 dBA in 2007. Average daily noise level was lower in living area except 2009 year and was between 65.2 dBA in 2010 to 72.4 dBA in 2009. The guideline values for specific environments have been exceeded during the all years.

		Trade-business -residential area N=5 GV =60 dBA		Residential area (living area) N=5 GV =55 dBA	
		X average	±SD	X average	±SD
2007	Leq dBA	*71.8*	*2.2*	*66.8*	*3.9*
2008	Leq dBA	*70.2*	*1.6*	*69.9*	*1.3*
2009	Leq dBA	*71.7*	*2.6*	*72.4*	*1.1*
2010	Leq dBA	*65.5*	*0.8*	*65.2*	*0.33*
2011	Lden dBA	*69.4*	*1.5*	*67.1*	*0.1*
2012	Lden dBA	*67.4*	*2*	*65.5*	*3.2*
2013	Lden dBA	*70.33*	*1.7*	*68.1*	*2.6*

Tab1. Results of noises measurements 2007 - 2013 (8)

If the noise is not continuous, sleep disturbance correlates best with LAmax and effects have been observed at 45 dB or less. However, when it comes to long-term protection, the number of events is equally

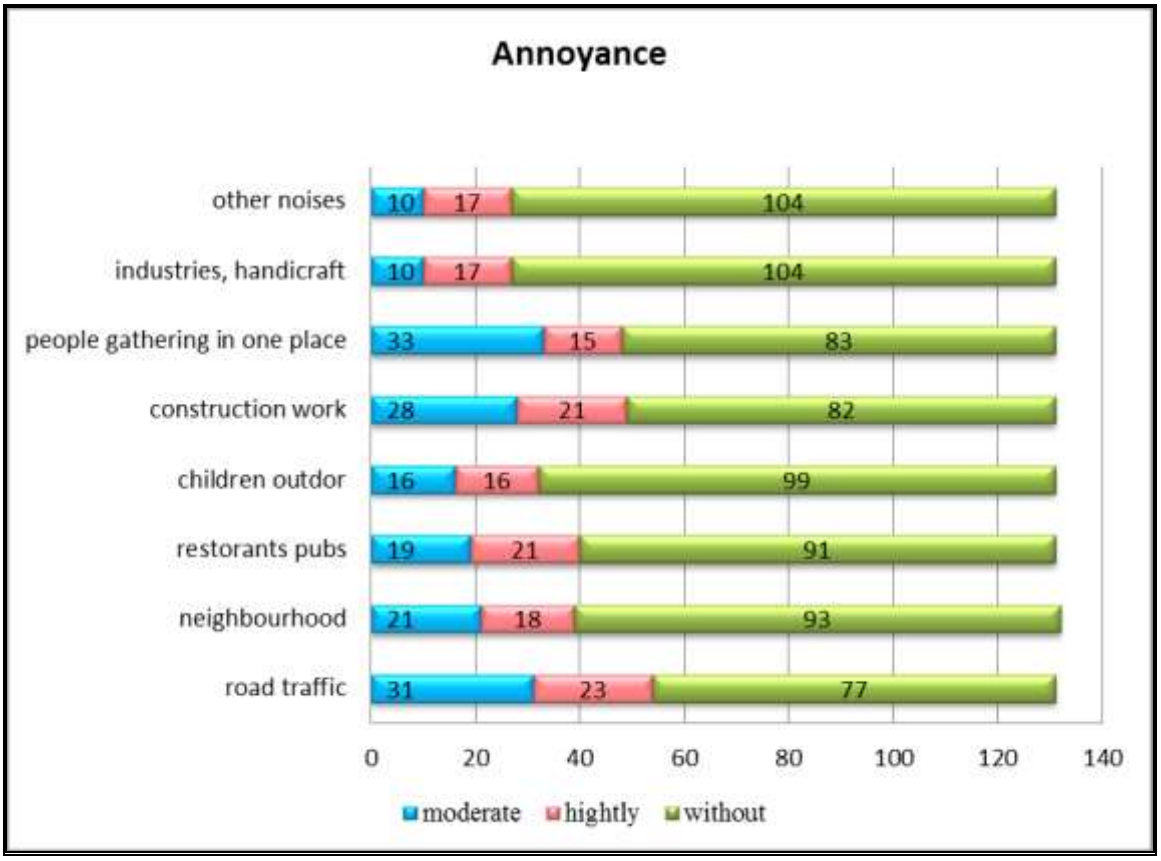
important [1, 5].

		Trade-business -residential area N=5 GV =55 dBA		Residential area (living area) N=5 GV =45 dBA	
		X average	LA max	X average	LA max
2011	Lnight dBA	*64.9*	*83.2*	*64.1*	*80.3*
2012	Lnight dBA	*63.5*	*85*	*60.02*	*83*
2013	Lnight dBA	*65.4*	*82.5*	*64.2*	*82*

Tab2. Results of night noises measurements 2011 - 2013 (8)

In this study as a noise exposure indicator were used Lden dBA and the noise exposure effects were evaluated by assessing the extent of annoyance among exposed individuals as a low, moderate and high. Noise annoyance is assessed by means of a questionnaire.

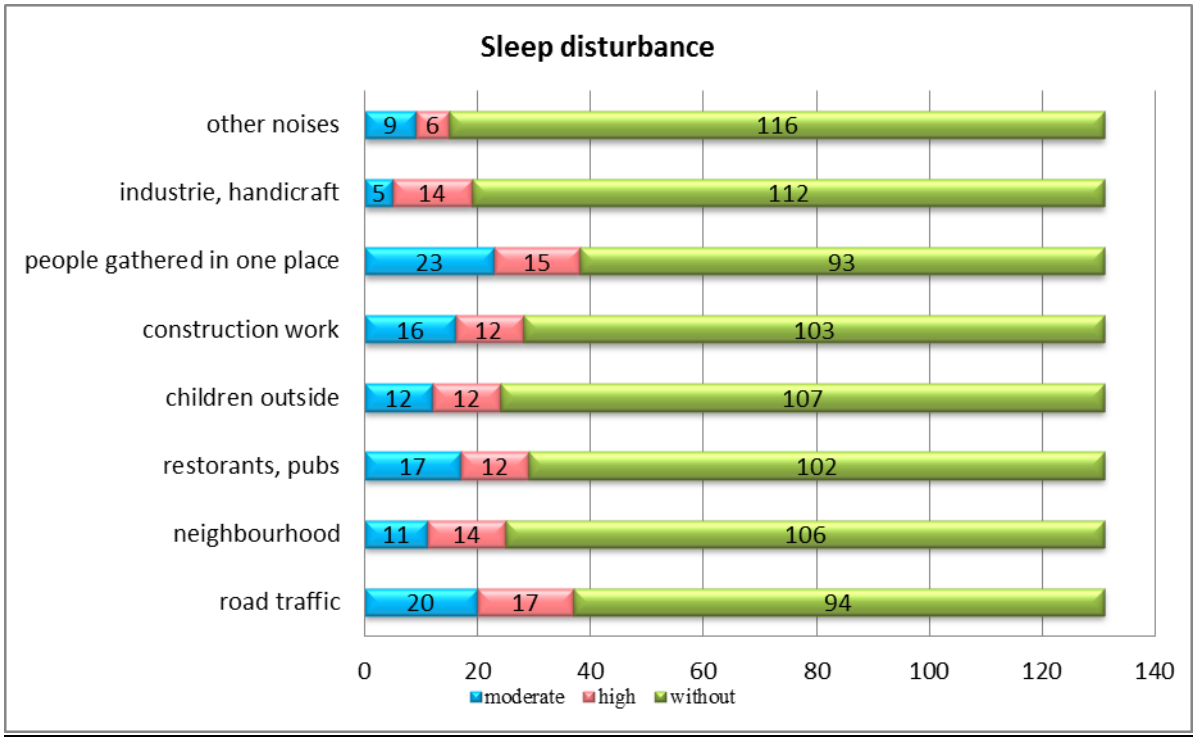
Analysis of the annoyance level in Kumanovo in the sample on a scale of 0 to 10 showed that 11.37 % of subjects reported a high level of annoyance, 13.74 % reported a moderate level of annoyance and 74.89 % felt no annoyance. Most annoying sources were road traffic noise, noise from people gathered in one place and construction activities.



Graf 1 The survey results regarding the occurrence of annoyance

Sleep disturbance is a major effect of environmental noise. It may cause primary effects during the sleep and secondary effects that can be assessed the day after night-time noise exposure, or so-called after effects. Questionnaire data indicate the importance of night-time noise on the perception of sleep quality.

Analysis of the sleep disturbance level showed that 10.8% of subjects reported moderate level of sleep disturbance and 9.7 % reported high sleep disturbance. Most frequent sources for sleep disturbance were noise from people gathered in one place and road traffic noise.



Graf 2 The survey results regarding the occurrence of sleep disturbance

A prospective study and a cross-sectional study carried out from Institute of Public Health in Macedonia in the adult population in Skopje from 2006-2008, showed that subjects exposed to Lday above 65 dBA and Lnight above 55 dBA were at risk of a high level of annoyance (RR=5.99), for a high level of sleep disturbance (RR=16.59), for hypertension and migraine (RR=1.8) and for chronic respiratory diseases (RR=1.38) [6].

Diseases of the circulatory system are in first place among non-communicable diseases in Kumanovo. Among the diseases of the circulatory system the leading one is essential hypertension. High blood pressure is present in the highest percentage among the diseases of the circulatory system and rates about 55.7% in 2011, 51.5% in 2012 and 54.4% in 2013.

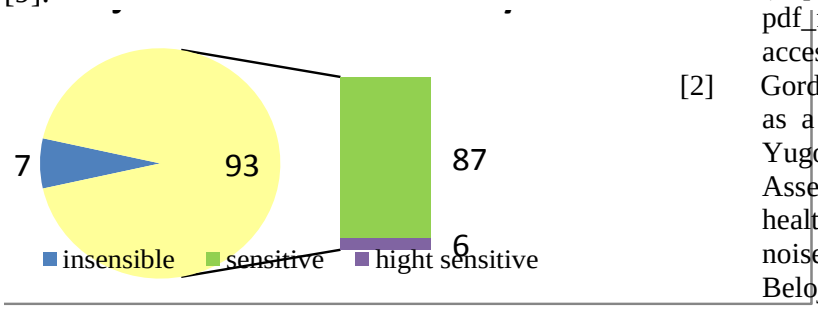
Diseases	**age 20-75+**	**2013**	**2012**	**2011**
Diseases of the circulatory system I00-I99	male	13738	16372	16931
	female	19236	20796	21674
	total number	**32974**	**37178**	**38605**
essential hypertension I10	male	6971	7399	8820
	female	10972	11846	12714
	total number	**17943**	**19145**	**21534**
acute myocardial infarction I21-I22	male	227	295	491
	female	60	113	82
	total number	**287**	**408**	**573**
other ischaemic heart diseases I20,I23-I25	male	1077	1291	1507
	female	952	1122	1371
	total number	**2029**	**2413**	**2878**

Tab 3. Results of diseases of the circulatory system 2011-2013 (10)

Often, the noise level is not of primary importance for the people's reaction to it as it has been proven through some research nearby international airports with a large traffic.

Differences in both the short-term reactions of people to noise and the possibilities of adaptation to loud sounds over an extended period, are most commonly explained by the

existence of higher or lower sensitivity to noise which are characteristic of every human being [9].



Graph 2 – Subjective noise sensitivity

Conclusion and recommendations

Research has shown that population in Kumanovo who live and work in trade-business-residential and residential areas were exposed to increased noise level and they reported annoyance and sleep disturbance. Exposure to environmental noise has an impact on public health and needs to be given a priority in the public health policy-making.

There is a need to establish and consolidate collaboration between the Institute of Public Health and Regional Institutes of public health for raising awareness about noise and carrying out epidemiological studies on the effects of noise and its adverse effects on health as well as for implementing methodologies and conducting risk assessments.

Local authority in Kumanovo should start developing a Strategic noise maps for agglomeration and main roads and action plans as a legal obligation.

Local authorities should undertake noise mitigation measures in order to protect human health and improve life quality.

References:

[1] Burden of disease from environmental noise: Quantification of healthy life years lost in Europe. Copenhagen, WHO Regional Office for Europe (2011). (http://www.euro.who.int/_data /assets/ pdf_file/ 0008/136466/e 94888.pdf, accessed 17 March 2012).

[2] Gordana Ristovska, Dragan Gjorgjev . Noise as a public health problem in the Former Yugoslav Republic of Macedonia in Assessment of capacity-building needs for health risk assessment of environmental noise: Case studies. Edited by: Goran Belojevic, Rokho Kim and Stylianos Kephalopoulos

[3] Irene van Kamp. - Noise and health from different perspectives. Proceedings of 20th International congress on acoustics, IAC 2010. (23-27.08.2010, Sydney, Australia)

[4] Guidelines for community noise. Geneva, World Health Organization, 1999 (http://whqlibdoc.who.int/hq/1999/ a68672.pdf, accessed 22 July 2010).

[5] Night noise guidelines for Europe, World Health Organization, 2009 (http: // www. euro. who. int / pubrequest).

[6] Ristovska G. Environmental health risk assessment of community noise in adult population in the city of Skopje [doctoral thesis]. Skopje, University SS Cyril and Methodius, Medical Faculty, 2010.

[7] Environmental statistics, 2011. Skopje, Republic of Macedonia State Statistical Office, 2011.

[8] Annual data report for quality of the environment. Skopje, Ministry of Environment and Spatial Planning, Macedonian Centre for Environmental Information, 2007-2013.

[9] Горан Бјелојевиќ. (1991) Субјективна осетљивост на буку. Срп арх целок лек 1991; 119 (7-8):221-3.

[10] Annual report for realization of preventive health care programme. Kumanovo RM, Center for public health, 2011-2013.