Assessment of needs for capacity-building for health risk assessment of environmental noise: case studies

A group of international experts met in Bonn in October 2010 to define and agree on the assessment of the burden of disease from environmental noise, with a focus on cardiovascular disorders and sleep disturbance, and to promote knowledge transfer and capacity-building in European countries in the area of health risk assessment of environmental noise. The needs for awareness-raising and capacity-building in new EU member states, south-eastern European countries and newly independent states were studied on the basis of reports of experts from Albania, Belarus, the Czech Republic, Georgia, Serbia, Slovakia, Slovenia and the former Yugoslav Republic of Macedonia. The following common needs were identified: harmonization of the implementation of the Environmental Noise Directive 2002/49/EC, especially for strategic noise mapping and noise action plans, human resources development through education and training in health risk assessment, and provision of methodological guidelines for health risk assessment of environmental noise exposure. WHO, the European Commission and expert networks are important in promoting the transfer of knowledge and building human and institutional capacities for environmental noise risk assessment.

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Rokho Kim
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Assessment of needs for capacity-building for health risk assessment of environmental noise: case studies

Edited by:
Goran Belojevic, Rokho Kim and Stylianos Kephalopoulos
ABSTRACT

A group of international experts met in Bonn in October 2010 to define and agree on the assessment of the burden of disease from environmental noise, with a focus on cardiovascular disorders and sleep disturbance, and to promote knowledge transfer and capacity-building in European countries in the area of health risk assessment of environmental noise. The needs for awareness-raising and capacity-building in new EU member states, south-eastern European countries and newly independent states were studied on the basis of reports of experts from Albania, Belarus, the Czech Republic, Georgia, Serbia, Slovakia, Slovenia and the former Yugoslav Republic of Macedonia. The following common needs were identified: harmonization of the implementation of the Environmental Noise Directive 2002/49/EC, especially for strategic noise mapping and noise action plans, human resources development through education and training in health risk assessment, and provision of methodological guidelines for health risk assessment of environmental noise exposure. WHO, the European Commission and expert networks are important in promoting the transfer of knowledge and building human and institutional capacities for environmental noise risk assessment.

Keywords

NEEDS ASSESSMENT
CAPACITY BUILDING
RISK ASSESSMENT
NOISE
ENVIRONMENTAL HEALTH
## CONTENTS

Abbreviations..................................................................................................................... v

Executive summary ........................................................................................................... vi

- Selected new members of the European Union........................................................ vi
- Selected countries in south-eastern Europe.............................................................. vi
- Selected newly independent states........................................................................... vii

Introduction....................................................................................................................... 1

Reference ......................................................................................................................... 1

Noise as a public health problem in Albania .......................................................................... 2

- Introduction .............................................................................................................. 2
- Noise policy and awareness ...................................................................................... 2
- Noise exposure data................................................................................................. 2
- Needs for knowledge transfer and capacity-building.................................................. 3

Noise as a public health problem in Belarus .......................................................................... 4

- Introduction .............................................................................................................. 4
- Needs for knowledge transfer and capacity-building.................................................. 4

Noise as a public health problem in the Czech Republic ......................................................... 6

- Introduction .............................................................................................................. 6
- Noise policy and awareness ...................................................................................... 6
- Noise exposure data................................................................................................. 8
- Research on noise and health ............................................................................... 9
- Needs for knowledge transfer and capacity-building.................................................. 9
- Conclusions ............................................................................................................. 10
- References ............................................................................................................... 10

Noise as a public health problem in Georgia ........................................................................ 11

- Introduction ............................................................................................................ 11
- Noise policy and awareness ...................................................................................... 11
- Needs for knowledge transfer and capacity-building.................................................. 13
- Conclusion............................................................................................................... 13
- References ............................................................................................................... 13

Noise as a public health problem in Serbia .......................................................................... 14

- Introduction ............................................................................................................ 14
- Noise policy and awareness ...................................................................................... 14
- Noise exposure data................................................................................................. 15
- Research on noise and health ............................................................................... 15
- Needs for knowledge transfer and capacity-building.................................................. 16
- Conclusion............................................................................................................... 16
- References ............................................................................................................... 16
<table>
<thead>
<tr>
<th>Country</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise as a public health problem in Slovakia</td>
<td>17</td>
</tr>
<tr>
<td>Introduction</td>
<td>17</td>
</tr>
<tr>
<td>Noise policy and awareness</td>
<td>18</td>
</tr>
<tr>
<td>Noise exposure data</td>
<td>21</td>
</tr>
<tr>
<td>Research on noise and health</td>
<td>23</td>
</tr>
<tr>
<td>Needs for knowledge transfer and capacity-building</td>
<td>23</td>
</tr>
<tr>
<td>Conclusion</td>
<td>25</td>
</tr>
<tr>
<td>References</td>
<td>26</td>
</tr>
<tr>
<td>Noise as a public health problem in Slovenia</td>
<td>27</td>
</tr>
<tr>
<td>Introduction</td>
<td>27</td>
</tr>
<tr>
<td>Noise policy and awareness</td>
<td>27</td>
</tr>
<tr>
<td>Noise exposure data</td>
<td>32</td>
</tr>
<tr>
<td>Research on noise and health</td>
<td>33</td>
</tr>
<tr>
<td>Needs for knowledge transfer and capacity-building</td>
<td>33</td>
</tr>
<tr>
<td>Conclusions</td>
<td>33</td>
</tr>
<tr>
<td>References</td>
<td>34</td>
</tr>
<tr>
<td>Noise as a public health problem in Macedonia</td>
<td>35</td>
</tr>
<tr>
<td>Introduction</td>
<td>35</td>
</tr>
<tr>
<td>Noise policy and awareness</td>
<td>35</td>
</tr>
<tr>
<td>Research on noise and health</td>
<td>36</td>
</tr>
<tr>
<td>Needs for knowledge transfer and capacity-building</td>
<td>37</td>
</tr>
<tr>
<td>Conclusion</td>
<td>37</td>
</tr>
<tr>
<td>References</td>
<td>37</td>
</tr>
<tr>
<td>Conclusion</td>
<td>38</td>
</tr>
</tbody>
</table>
Abbreviations

CNOSSOS-EU  Common Noise aSSessment methOdS in EUrOpe
DALY      disability-adjusted life year
EBoDE     environmental burden of disease in Europe
EIONET    European Environment Information and Observation Network
END       Environmental Noise Directive
ENNAH     European Network on Noise and Health
ICBEN     International Commission on Biological Effects of Noise
Executive summary

On 14 and 15 October 2010, a group of international experts and representatives of the European Commission’s Joint Research Centre and the European Environment Agency was convened in Bonn by the WHO European Centre for Environment and Health (Bonn) to define and agree on the assessment of the burden of disease from environmental noise, with a focus on cardiovascular disorders and sleep disturbance, and to promote the transfer of knowledge and capacity-building in European countries in the area of health risk assessment of environmental noise. This document summarizes their reports on the needs of selected countries in three sub-regions: new members of the European Union (EU) (Czech Republic, Slovakia, Slovenia), south-eastern European countries (Albania, Serbia, the former Yugoslav Republic of Macedonia) and the newly independent states (Belarus, Georgia).

Selected new members of the European Union

In the Czech Republic, the Ministry of Health and 14 regional public health authorities, supported by regional public health institutes, are responsible for public health safety supervision and noise regulation. All the requirements of the EU’s Environmental Noise Directive 2002/49/EC (END) for strategic noise mapping and environmental noise action plans have been met. Noise is predominantly regarded as a public health problem.

In Slovakia, the Ministry of Health and the national and regional public health authorities are responsible for dealing with problems of noise pollution. The END has been transposed into local legislation, with the first phase of strategic noise mapping completed in 2007. Plans have been developed for protection against noise in areas around major roads. Slovakia is included in the European Network on Noise and Health (ENNAH) because of the long-term research on noise and health.

Slovenia adopted the END in 2004. The responsible authority is the Ministry of the Environment and Spatial Planning, in collaboration with the Environmental Agency of the Republic of Slovenia and municipalities and the Ministries of Transport and of Health. The Ministry of Health and the National Institute of Public Health Authorities are responsible for public health aspects of environmental noise. The Ministry of the Environment and Spatial Planning is responsible for providing strategic noise maps. All the requirements of the END for strategic noise mapping have been met.

Selected countries in south-eastern Europe

In Albania, national legislation is being harmonized with European legislation. Based on the END, Law No. 9774 on the management and assessment of urban noise was approved by Parliament in 2008. National noise limits in accordance with WHO recommendations have been introduced. The Ministry of Environment, Forest and Water Administration is responsible for management of environmental noise.

In Serbia, the Ministry of Environment and Spatial Planning is responsible for environmental noise and public health, together with the Environmental Protection Agency and the national and regional public health institutes. The Law on Protection from Environmental Noise was introduced in May 2009 in full accordance with the END. Serbia is one of the non-EU countries included in ENNAH and the International Commission on Biological Effects of Noise (ICBEN) because of the long-term research on noise and health.
In the former Yugoslav Republic of Macedonia, the management of environmental noise is regulated by the Law on Environmental Noise Protection, which is harmonized with the END. The authority responsible for collecting data is the Ministry of Environment and Physical Planning. Strategic noise maps have not been prepared. National limit values for prevention of noise adverse effects have been established in compliance with WHO recommendations by the Ministry of Health, which is responsible for assessment of noise-induced health effects.

**Selected newly independent states**

In Belarus, noise pollution is growing, mainly from transport and industrial development. There is a lack of knowledge for the assessment of noise pollution, of noise risk for vulnerable groups, and of the combined influence of environmental factors such as air pollution and stress. Capacity-building is needed in the fields of noise legislation and human resources through information exchange and pilot projects.

Georgia has not yet implemented the EU legislation relating to sources of noise. The Ministry of the Environment and Natural Resources and the Ministry of Labour, Health and Social Affairs are responsible for environmental noise and public health. They are working with the National Centre for Disease Control and Public Health on a new monitoring model to include all environmental health components.

Common needs for transfer of knowledge and capacity-building in new EU countries, SEE and NIS were identified in the following areas:

- harmonization of the adoption and implementation of the END, especially in preparing strategic noise mapping and action plans;
- human resources development through education and training in health risk assessment and the burden of diseases from environmental noise;
- provision of methodological guidelines for health risk assessment of environmental noise.
Introduction

In 2009, the WHO European Centre for Environment and Health (WHO-ECEH) in Bonn supported a project on estimating the burden of disease for selected environmental stressors (the EBoDE project), including environmental noise, in six countries. Preliminary results have shown that environmental noise is the third largest factor, after ambient air pollution and exposure to second-hand smoke, in the environmental burden of disease in these countries as expressed in disability-adjusted life years (DALYs). The burden of cardiovascular disease and sleep disturbance from environmental noise can be estimated in countries where strategic noise maps are available. Unfortunately, data and information on the exposure level and health impacts of environmental noise are very limited in many WHO European Member States. There is a need for a transfer of knowledge and capacity-building in these countries.

The Parma Declaration, which was adopted at the Fifth Ministerial Conference on Environment and Health in March 2010, mentioned environmental noise as a priority (1). In accordance with regional priority goal 4 (v) of the Commitment to Act in the Declaration, WHO-ECEH convened a group of international experts and representatives of the European Commission’s Joint Research Centre and the European Environment Agency in Bonn on 14-15 October 2010 to define and agree on the assessment of the burden of disease from environmental noise, with a focus on the burden of cardiovascular disorders and sleep disturbance, and how to promote the transfer of knowledge and capacity-building in European countries for health risk assessments of environmental noise. They also assessed the need to raise awareness and build capacity in new EU countries, south-eastern European countries and the newly independent states regarding the health risks from environmental noise.

The documents presented at the meeting included reports on the situation as regards noise policies in Albania, Belarus, the Czech Republic, Georgia, Serbia, Slovakia, Slovenia and the former Yugoslav Republic of Macedonia.

The meeting concluded that WHO, the European Environmental Agency (EEA) and the European Commission’s (EC) Directorate-General for the Environment (DG ENV) and the Joint Research Centre (JRC), together with professional networks such as the European Network on Noise and Health (ENNAH) and the International Commission on Biological Effects of Noise (ICBEN), as well as national experts should cooperate on the development of national and regional environmental noise and health policies and on the pan-European estimation of the burden of health impacts of environmental noise.

Since few documents are available that assess the relevant policies and professional capacities in the new EU member states, the south-eastern European countries and the newly independent states, this report was prepared on the basis of the country reports presented at the meeting.

Reference

Noise as a public health problem in Albania

Shkelqim Memaj

Introduction

Albania, in south-eastern Europe, has a population of around four million people. The capital, Tirana, is the largest city with a population of 500 000 in the centre and about 700 000 including the new surrounding urban centres. The other urban centres, excluding the harbour city of Durres with 250 000 citizens (30 km west of Tirana), have around or less than 100 000 citizens.

Noise policy and awareness

In the framework of the country’s attempts to join the EU, national legislation is in the process of being harmonized with European legislation. Environmental noise management has been partly adopted and implemented: based on the END, Law No. 9774 of 7 July 2007 on the management and assessment of urban noise was approved by Parliament and, in 2008, national noise limits were introduced in accordance with WHO recommendations.

The Ministry of the Environment, Forest and Water Administration is the authority responsible for management of environmental noise. It is suggested that a technical council under the Ministry should lead the management of the problem.

Under Article 7 of the Law, a sector for noise should be established in the Institute of Public Health (under the Ministry of Health) and serve as a reference base unit for measurements, monitoring and assessments. Article 20 states that the Ministry of the Environment is to compile the national action plan for protection from environmental noise within five years of the Law coming into force (2012). Article 21 states that mapping of noise at national and local levels should be carried out according to guidelines and methodologies approved by the Minister.

Since the technical council has not yet been established, information is not available for the Minister, and new directives (laws, guidelines and regulations) for organizing the practical work have not been approved.

Noise exposure data

Noise control started early in the 1970s at the Institute of Public Health and was mainly concerned with monitoring and assessing occupational exposure in industry, where about 40 000 workers had to endure high noise levels (above 85-90 dBA) for eight hours.

Some monitoring of noise levels from industrial sources next to residential areas was carried out, but generally urban exposure was not a serious problem.

After the political changes and the collapse of industry, economic activities developed in different ways and in the early years of this century it was clear that traffic was a serious contributor to urban noise.

1 Institute of Public Health, Tirana, Albania.
Before 1990, there were around 25 000 cars, lorries and all kinds of vehicle (including military vehicles) on the roads. At present there are around 350 000 and this number is growing rapidly. More than 50% are very old (20-25+ years) and fewer than 10% are new. This is, of course, reflected in both air pollution and noise.

Strategic noise maps for agglomerations and main roads and action plans have not yet been developed.

Nevertheless, monitoring has begun and in 2002-2008 was regularly carried out by the Institute of Public Health, financed in the framework of the national monitoring programme by the Ministry of the Environment, Forest and Water Administration. Tirana is a good example of a noise-polluted agglomeration. Fifteen measuring points were fixed in the most critical noise areas (busy crossroads) in Tirana, six in Durres and four each in another six urban centres. Owing to limited equipment, experts and finance, the scheme was reduced. Nevertheless, this monitoring was important for getting a good picture of noise levels, both day and night, and raising awareness among the public and the authorities.

Table 1 gives some average results from the noise measurements in urban centres containing more than 30% of the population.

<table>
<thead>
<tr>
<th>Agglomeration</th>
<th>$L_{eq}$ dBA</th>
<th>$L_{eq}$ N dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tirana</td>
<td>71</td>
<td>62</td>
</tr>
<tr>
<td>Durresi</td>
<td>68</td>
<td>50</td>
</tr>
<tr>
<td>Fieri</td>
<td>64</td>
<td>43</td>
</tr>
<tr>
<td>Shkodra</td>
<td>67</td>
<td>42</td>
</tr>
<tr>
<td>Elbasan</td>
<td>68</td>
<td>39</td>
</tr>
<tr>
<td>Vlora</td>
<td>65</td>
<td>48</td>
</tr>
<tr>
<td>Korca</td>
<td>61</td>
<td>43</td>
</tr>
<tr>
<td>Saranda</td>
<td>63</td>
<td>45</td>
</tr>
</tbody>
</table>

Some attempts have been made to establish the percentages of the population exposed to different noise levels and, based on modest monitoring data, to conduct some assessments of the possible influence of noise. More cooperation is needed between the health sector, the environmental authorities and other interested institutions.

**Needs for knowledge transfer and capacity-building**

The following needs for knowledge transfer and capacity-building have been recognized:

- improvements in legislation, especially to allocate responsibilities at different levels;
- updating the capacities of the national reference centre for noise in the Institute of Public Health, which will serve as a model for other units (including private ones) involved in activities such as measuring noise and assessing and offering protection services from noise;
- help with surveys on the effects of noise on cardiovascular disease and sleep disturbance;
- support for and establishment of specialized responsible bodies, an important factor in serious planning and support projects with all partners, starting with WHO.
Noise as a public health problem in Belarus

Irina Zastenskaya,2 Stanislav Khudnitsky2

Introduction

The intensity of noise pollution is growing in the newly independent states, mainly stemming from transport and economic (industrial) development. In Belarus, over the last ten years the level of noise has increased in the capital city, Minsk, by 2-5 dBA and in other towns by 3-4 dBA. When there are limited resources for protection measures, the needs for risk assessments and provision of scientific evidence of socioeconomic losses due to negative health impacts become more urgent. Indirect confirmation of the problem comes from the number of complaints to authorities about noise, as well as the high prevalence of cardiovascular diseases in all newly independent states, for which noise is a risk factor.

Needs for knowledge transfer and capacity-building

The aim of this short report is to identify the main gaps in capacities to evaluate the burden of disease caused by environmental noise and in the necessary transfer of knowledge to manage the risks attached to environmental noise on a scientific basis.

Research into the impact on health of environmental noise has been carried out on the basis of methodological documents developed at national level. The main aim of these studies has been to develop national standards, identify the main sources of noise and their contribution to environmental pollution, and develop recommendations to reduce noise levels. For various reasons, no study has been made of the burden of disease based on WHO methodology.

The main problems and limitations in relation to the environmental noise burden for disease are the following.

- **Lack of knowledge for integrated assessment of noise pollution.** It is well-known that both the level and the characteristics of noise have an impact on health. A simple methodology for assessment would make it possible to standardize the process and provide possibilities for comparative investigation at country, regional and sub-regional levels.

- **Lack of knowledge of noise risk for vulnerable groups of the population (children, people with health disorders, older people).** This is important from different points of view: children spend more time in noisy surroundings and it is difficult to protect them from noise related to behavioural characteristics, while elderly people are more sensitive to noise.

- **Lack of knowledge to evaluate the risk from the combined influences of different environmental factors.** These include, among other things, air pollution and stress (for example, how to separate the effects and evaluate the contribution of each factor, including a methodology to determine population groups for epidemiological studies), bearing in mind that the bodily organs and systems subject to influence from noise (the cardiovascular and nervous systems) are also targeted by hazardous chemicals such as lead, nitrates and particulate matter.

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2 Republican Scientific Practical Centre of Hygiene, Minsk.
For such knowledge to be used and risk assessments to be implemented in practice, the need for capacity-building is crucial in areas such as:

- legislation (good practice in implementing the precautionary principle);
- human resources development (education and training for different kinds of audience);
- information exchange (a panel of experts can be recommended to provide consultation if necessary); and
- financial support for pilot projects to show that health is an economic category and money can be saved by limiting the functions of the health system.

The problems are not the same at local and national levels. For example, the transfer of knowledge is more important for scientific institutions at national level, whereas at local level, key activities should be directed towards capacity-building in local-level institutions for implementing methodologies and conducting risk assessments.
Noise as a public health problem in the Czech Republic

Tomas Hellmuth

Introduction

The Czech Republic lies in the centre of Europe. It has an area of 78 867 km² and a high density road and rail infrastructure (Table 2). In 2009, the population was 10 491 492, with a density of 113 per km².

Table 2. Transport infrastructure, Czech Republic, 2012

<table>
<thead>
<tr>
<th>Transport infrastructure</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads</td>
<td>km</td>
</tr>
<tr>
<td>Total length</td>
<td>55 653</td>
</tr>
<tr>
<td>Highways and speedways</td>
<td>1 050</td>
</tr>
<tr>
<td>First-class roads</td>
<td>5 850</td>
</tr>
<tr>
<td>Second-class roads</td>
<td>14 592</td>
</tr>
<tr>
<td>Third-class roads</td>
<td>34 151</td>
</tr>
<tr>
<td>Railways</td>
<td></td>
</tr>
<tr>
<td>Total length</td>
<td>9 486</td>
</tr>
<tr>
<td>Electrified</td>
<td>3 078</td>
</tr>
<tr>
<td>Airports</td>
<td>No.</td>
</tr>
<tr>
<td>Total number</td>
<td>102</td>
</tr>
<tr>
<td>International public airports</td>
<td>7</td>
</tr>
<tr>
<td>Military airports</td>
<td>5</td>
</tr>
</tbody>
</table>

Noise policy and awareness

Statutory public health safety supervision and regulation is provided by the Ministry of Health and 14 regional public health authorities, supported by regional public health institutes which provide laboratory services, lifestyle promotion and medical support, including vaccinations.

There are many private laboratories and institutions dealing with the measurement of noise, the development of acoustic studies and advisory services in the fields of noise and acoustics. Most are accredited by the Institute for Accreditation, although only the Ministry of Health can accredit or authorize them to carry out measurements for official public health safety purposes.

Noise legislation

The relevant legislation is the Public Health Safety Act No. 258/2000 Col. as amended and Government Regulation No. 148/2006 Sb. Col. These set out the responsibilities as regards the regulation of noise, the methods of noise assessment and the limits for noise in relation to health in the living and occupational environments, using health risk assessment as a legislative tool. Decree No. 523/2006 Col. of the Ministry of Health on noise mapping and Decree No. 561/2006 Col. of the Ministry of Local Development on the list of agglomerations for noise mapping are also relevant.

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3 Public Health Institute of Ostrava, National Reference Laboratory for Community Noise, Ministry of Health.
Strategic noise maps and action plans

Noise mapping based on field noise measurements started in about 1980. Since 1990, computational methods for noise mapping and predictions have been used.

The Ministry of Health is responsible for providing strategic noise maps in accordance with the END (1). It also coordinates action plans provided by regional authorities and the Ministry of Transport (2).

Between 2005 and 2009, the country met all the requirements of the END for strategic noise mapping and provision of action plans (3).

Noise sources for strategic noise mapping

Table 3 and Figs. 1-4 show the sources of noise mapped in the first and second rounds in accordance with the END.

Table 3. Sources of noise for strategic noise mapping, Czech Republic

<table>
<thead>
<tr>
<th>Source</th>
<th>First round</th>
<th>Second round</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agglomerations (km²):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prague</td>
<td>496</td>
<td>772</td>
</tr>
<tr>
<td>Brno</td>
<td>230</td>
<td>328</td>
</tr>
<tr>
<td>Ostrava</td>
<td>214</td>
<td>248</td>
</tr>
<tr>
<td>Plzeň</td>
<td>184</td>
<td></td>
</tr>
<tr>
<td>Ústí nad Labem-Teplice</td>
<td>171</td>
<td></td>
</tr>
<tr>
<td>Liberec</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>Olomouc</td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>940</td>
<td>1968</td>
</tr>
<tr>
<td>Main airport: Praha-Ruzyně</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Main roads (km)</td>
<td>1370</td>
<td>3921</td>
</tr>
<tr>
<td>Main railways (km)</td>
<td>300</td>
<td>2000</td>
</tr>
</tbody>
</table>

Fig. 1. Noise mapping, first round: main roads and agglomerations, Czech Republic

Source: Institute of Public Health (3).
**Awareness of noise as a public health problem**

The Ministry of Health is responsible for public health safety and matters relating to noise. Noise in public areas is increasingly being considered a public health problem, not just an environmental problem.

**Noise exposure data**

Table 4 gives data based on strategic noise maps showing the number and percentage of people exposed to a noise level of 55 dBA and over in major agglomerations and around major roads, railways and airports. These data are used for environmental impact assessments, land use planning and resolution of complaints, as well as for calibrating noise maps and acoustical studies.
Research on noise and health

No fundamental research concerning the effects of environmental noise on sleep, cardiovascular diseases and annoyance has been carried out.

Needs for knowledge transfer and capacity-building

The country has adequate legislation and human and technical resources to carry out health risk assessments of environmental noise exposure. The END has been adopted and implemented in national legislation. The main problem is funding strategic noise mapping. International cooperation with the EC Directorate-General for the Environment (DG ENV) and Joint Research Centre (JRC), EEA, ENNAH, ICBEN and WHO is essential. Cooperation mainly occurs through the European Environment Information and Observation Network (EIONET) national reference centres as regards noise and participation in the Regulatory Noise Committee of the EC Directorate-General for the Environment, and specialized bodies such as the Technical Committee for the Common Noise Assessment methods (CNOSSOS-EU) framework. There is
a need for an official common (pan-European) methodology and step-by step guidance for health risk assessment of environmental noise exposure, including recommendations for some scale of acceptable risks.

**Conclusions**

The Czech Republic has a long tradition of, and adequate human and technical resources for, health risk assessment of environmental noise exposure and noise mapping.

The general principles of health risk assessment have been incorporated into national legislation.

Official common (pan-European) methods and step-by step guidance for health risk assessments of environmental noise exposure, including recommendations for some scale of acceptable risks, are urgently needed. These methods could be incorporated quickly into national legislation through a ministerial decree or government regulation.

**References**

Noise as a public health problem in Georgia

Nana Gabriadze

Introduction

Georgia covers 69 700 km\(^2\). At the beginning of 2010, the population was 4 436 400 (2 350 500 urban and 2 085 900 rural), with a density of 76 per km\(^2\).

The agglomerations and areas, major roads and railways that are relevant for noise mapping are presented in Tables 5 and 6. The major civil airports are Tbilisi, Kutaisi and Batumi.

Table 5. Population of municipalities, Georgia, 2010

<table>
<thead>
<tr>
<th>Name</th>
<th>Population (000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tbilisi</td>
<td>1152.5</td>
</tr>
<tr>
<td>Autonomous Republic of Adjara</td>
<td>386.9</td>
</tr>
<tr>
<td>Batumi</td>
<td>123.5</td>
</tr>
<tr>
<td>Imereti</td>
<td>700.4</td>
</tr>
<tr>
<td>Kutaisi</td>
<td>192.5</td>
</tr>
<tr>
<td>Samegrelo-Zemo</td>
<td>474.1</td>
</tr>
<tr>
<td>Zugdidi</td>
<td>175.0</td>
</tr>
<tr>
<td>Kvemo Kartli</td>
<td>499.9</td>
</tr>
<tr>
<td>Rustavi</td>
<td>119.5</td>
</tr>
<tr>
<td>Marneuli</td>
<td>126.3</td>
</tr>
<tr>
<td>Shida Kartli</td>
<td>310.6</td>
</tr>
<tr>
<td>Gori</td>
<td>144.1</td>
</tr>
<tr>
<td>Kacheti</td>
<td>404.5</td>
</tr>
</tbody>
</table>

Source: WHO Regional Office for Europe (1).

Table 6. Total length of major railways and roads, Georgia

<table>
<thead>
<tr>
<th>Railways/roads</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Railways</td>
<td>1 561</td>
</tr>
<tr>
<td>Roads</td>
<td>20 329</td>
</tr>
</tbody>
</table>

Source: Parliament of Georgia (2).

Noise policy and awareness

The EU legislation relating to sources of noise and development of a long-term EU strategy has not been implemented in Georgia.

\(^4\) National Centre for Disease Control and Public Health of Georgia, Tbilisi.
Authorities responsible for environmental noise and public health

The Ministry of Environment and Natural Resources (3) ensures that:

- national policy is integrated and implemented through state regulation of a safe environment, in accordance with the principles of sustainable development and management of natural resources;
- the environment is protected from negative physical factors that may have an impact on public health;
- there is a national system for planning, monitoring of physical factors and implementation of measures as regards limitations.

The Ministry of Labour, Health and Social Affairs (4) determines the norms and technical regulations for a safe environment for the public.

Noise legislation

From 1991 to 2005, the State Sanitary Inspectorate was responsible for environmental health services such as inspection of air and water quality, waste collection activities, food hygiene, noise level measurement, occupational health, work safety and certification of facilities in relation to environmental health. According to the Law on Public Health (2007), the Ministry of Labour, Health and Social Affairs is now responsible for establishing sanitary/hygienic norms and standards for air, water, soil, noise, vibration, ionizing and non-ionizing emissions and chemical safety. The Ministry of Environmental Protection and Natural Resources is responsible for monitoring environmental conditions (water quality, air, electromagnetic fields and so on). The National Centre for Disease Control and Public Health, under the Ministry of Labour, Health and Social Affairs, and its subordinate epidemiological units monitor communicable and non-communicable diseases and environmental health risk factors.

Sanitary norms for noise at workplaces, in houses and public buildings and in populated areas were adopted in 2001 by a decree of the Minister of Labour, Health and Social Affairs. The measurement of noise has, however, never been included in the environmental monitoring system.

Strategic noise maps and action plans

Strategic noise maps and action plans have not been drawn up. There is a need for work in this area, for the public to be informed about noise exposure and its health effects, and for action plans to be designed.

Accredited laboratories for noise exposure assessment

There are some private laboratories accredited by the National Accreditation Body.

Awareness of noise as a public health problem

Work is needed on this problem. The National Centre for Disease Control and Public Health and the Ministry of Labour, Health and Social Affairs, in cooperation with the Ministry of Environmental Protection and Natural Resources, are trying to establish a new monitoring model to include all environmental health components. Planned major changes include an updating of the sanitary norms and their harmonization with EU environment legislation (5).
**Noise exposure data**

There are no data on the number of people exposed to noise levels of 55 dB or higher (6).

**Needs for knowledge transfer and capacity-building**

There are essential needs in the following areas:

- the development of human resources, through education and training for health risk assessment and the burden of disease from environmental noise;
- financial resources;
- the development of technical resources, because of inadequate logistics, laboratory equipment and facilities;
- the adoption and implementation of the END;
- the establishment of international standards on noise in accordance with WHO recommendations, including the observation and development of existing EU legislation relating to sources of noise (such as motor vehicles, aircraft and railway rolling stock) and the provision of financial support for noise-related studies and research projects;
- international cooperation with the EC (Directorate-General for the Environment and the Joint Research Centre), ENNAH, ICBEN and WHO;
- the establishment of official pan-European methods and step-by step guidelines for health risk assessment of environmental noise exposure, including recommendations for some scale of acceptable risks.

**Conclusion**

Georgia needs great support in adopting and implementing the END for assessment and management of environmental noise. Capacity-building for technical and human resources will facilitate the process for accession to the EU and will also enable the health authorities to do more about the impact of noise on public health. There is a great need to develop the national environmental health action plan.

**References**

Noise as a public health problem in Serbia

Goran Belojevic,5 Katarina Paunovic,5 Branko Jakovljevic,5 Vesna Stojanov6

Introduction

Serbia is a landlocked country in the Balkan peninsula, with an area of 88 361 km² and a population of around 10 100 000. Population density is 114 per km². The capital is Belgrade: with a population of around 1.7 million, it is one of the largest cities in south-eastern Europe.

Agglomerations (areas in km²), main roads and main railways (length in km) that are relevant for noise mapping are shown in Table 7.

<table>
<thead>
<tr>
<th>Source</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agglomerations (population in urban areas)</td>
<td>Belgrade (1 525 000)</td>
</tr>
<tr>
<td></td>
<td>Pristina (550 000)</td>
</tr>
<tr>
<td></td>
<td>Nis (396 000)</td>
</tr>
<tr>
<td></td>
<td>Novi Sad (276 000)</td>
</tr>
<tr>
<td></td>
<td>Kragujevac (160 000)</td>
</tr>
<tr>
<td></td>
<td>Leskovac (310 000)</td>
</tr>
<tr>
<td></td>
<td>Subotica (106 000)</td>
</tr>
<tr>
<td>Major roads (km, estimated)</td>
<td>E65 (150)</td>
</tr>
<tr>
<td></td>
<td>E70 (211)</td>
</tr>
<tr>
<td></td>
<td>E75 (572)</td>
</tr>
<tr>
<td></td>
<td>E80 (316)</td>
</tr>
<tr>
<td></td>
<td>E662 (78)</td>
</tr>
<tr>
<td></td>
<td>E761 (273)</td>
</tr>
<tr>
<td></td>
<td>E763 (285)</td>
</tr>
<tr>
<td></td>
<td>E771 (194)</td>
</tr>
<tr>
<td></td>
<td>E851 (74)</td>
</tr>
<tr>
<td></td>
<td>Total (2 153)</td>
</tr>
<tr>
<td>Major railways (km, estimated)</td>
<td>1 143</td>
</tr>
<tr>
<td>Major airports (movements per year)</td>
<td>Belgrade (44 600)</td>
</tr>
</tbody>
</table>

Noise policy and awareness

The authorities responsible for environmental noise and public health are the Ministry of Environment and Spatial Planning with the Environmental Protection Agency, the Republic Public Health Institute and 22 regional public health institutes.

There are 36 laboratories accredited for environmental noise measurements. The Law on Protection from Environmental Noise was introduced in May 2009 and is fully adapted to the END. The deadline for the first round of noise mapping is 30 June 2012 and the second round 31 December 2017. Action plans should be completed at the latest one year after completion of the noise mapping.

5 Institute of Hygiene and Medical Ecology, School of Medicine, University of Belgrade.
6 Centre for Hypertension, Clinical Centre of Serbia, School of Medicine, University of Belgrade.
For decades, noise has been regarded as a major public health problem both in annual reports from the Republic Public Health Institute and in public opinion inquiries.

**Noise exposure data**

Systematic noise measurements have been made in the cities of Belgrade, Kragujevac and Novi Sad. The results of noise measurements in Belgrade in the last 30 years have shown that noise limits in residential zones ($L_{eq}$ 55 dB for day and 45 dB for night) have been exceeded by 11-16 dB during the day and by 10-14 dB at night (1). Noise measurements in Kragujevac have been made once a month since 2004 at three measuring spots in residential areas. Noise limits for day and night have been exceeded by 4 dB and 11 dB, respectively (2). Noise measurements in Novi Sad are carried out once a month in 13 measuring spots in the urban area. The average daily $L_{eq}$ is 68 dBA, ranging from $L_{eq}$ 64 to 74 dBA (3).

**Research on noise and health**

Serbia is one of the non-EU countries included in ENNAH and ICBEN owing to the long-term research on noise and health carried out at the Belgrade School of Medicine. The Belgrade Team for Biological Effects of Noise started international cooperation in this field in 1990 through a joint project with the Institute of Environmental Medicine at Gothenburg University in Sweden (4).

**Sleep disturbance**

In 2005, a cross-sectional study was carried out of 310 residents of Belgrade, 192 living in a noisy area ($L_{eq} >$65 dBA) and 118 in a quiet area ($L_{eq} <$5 dBA). After adjustment for potential modifying personality traits, including subjective noise sensitivity, neuroticism and extroversion, residence in a noisy area was shown to be a significant predictor of difficulties with falling asleep (odds ratio (OR) = 2.71; 95% confidence interval (CI) = 1.27-5.80), difficulties with getting back to sleep (OR = 1.87; 95% CI = 1.02-3.40), waking up at night (OR = 2.60; 95% CI = 1.49-4.52), sleeping with the windows closed (OR = 2.99; 95% CI = 1.13-7.89) and feeling tired after sleep (OR = 2.50; 95% CI = 1.11-5.63) (5).

**Cardiovascular effects**

In a population study of the cardiovascular effects of noise, the adjusted OR for arterial hypertension was 1.58 (95% CI = 1.03-2.42) in people exposed to night-time noise >45 dBA compared to people exposed to night-time noise ≤45 dBA (6). In another population study of Belgrade pre-schoolchildren aged 3-7 years, systolic pressure was significantly higher (5 mm Hg on average) in children in noisy residences and kindergartens compared to children in quiet environments ($P <0.01$) (7).

**Noise annoyance**

Population studies of adult residents of Belgrade found that the best three predictors of high noise annoyance were: subjective noise sensitivity (OR = 4.999; 95% CI = 3.690–6.771), windows facing the street (OR = 2.600; 95% CI = 2.043–3.310) and night-time noise levels (OR = 1.018; 95% CI = 1.001–1.035) (8,9).
Needs for knowledge transfer and capacity-building

Noise experts in Serbia have a long tradition of cooperation with ICBEN (Professor Belojevic has been a member of Scientific Team 3 since 1993). The Institute of Hygiene and Medical Ecology is included in the ENNAH FP7 project. The ENNAH young researcher exchange programme has funded the research of Katarina Paunovic from the University of Belgrade at Queen Mary, University of London (United Kingdom) on novel methods of blood pressure measurements in children in relation to noise exposure. Within ENNAH, Serbia will cooperate closely with experts from the United Kingdom in a forthcoming project on bioimpedance monitoring of the cardiovascular effects of noise.

The greatest challenge is the full implementation of the END in terms of noise mapping and noise action plans. Serbian noise experts will need advisory help from the EC (Directorate-General for the Environment and Joint Research Centre) and the EEA.

Conclusion

The END has been fully adopted through the Law on Environmental Noise Protection, but forthcoming noise mapping and noise action plans will be a challenging task for Serbian noise experts. Knowledge transfer and capacity-building in this field is of great importance. Advisory help will be needed from the EC (Directorate-General for the Environment and Joint Research Centre), the EEA and noise experts from EU countries who have already carried out noise mapping.

References

Noise as a public health problem in Slovakia

Ľubica Argalášová-Sobotová,7 Ladislav Mihalčík,8
Michal Jajcaj,9 Jana Jurkovičová,7 Ludmila Ševčíková7

Introduction

Environmental noise, particularly road traffic noise, has attracted widespread attention in recent decades as a major environmental health concern, especially in big cities. In Slovakia, the rapid development in traffic density connected with the economic transformation since 1990 has brought new problems in relation to environmental noise.

Slovakia has an area of 49,035 km² and an estimated population of 5,429,763 (2010) (1). The population density is 111 per km². The capital, Bratislava, has 546,300 inhabitants.

Noise sources

Road traffic is the major source of environmental noise, including from lorries. In the last decade it has increased by 40% in the larger cities.

Railways are also a major source of noise, mainly due to the lack of up-to-date technical equipment and inadequate maintenance of railways in the vicinity of residential buildings, as well as the absence of noise-suppressing measures.

The major civil airport is in the Bratislava agglomeration (Milan Rastislav Štefánik airport), with 30,500 movements in 2006. Air transport is a major source of noise for the eastern part of Bratislava and the adjacent villages. The military airport in the district of Malacky is a significant source of noise, especially during military air training.

Noise from industrial and construction activities is also very important. Technical infrastructure components of buildings (such as heating, cooling and air-conditioning plants and pneumatic facilities), production facilities and shopping centres are among the stationary sources of noise (2).

Strategic noise mapping

Table 8 and Fig. 5 show: (i) the areas (in km²) of agglomerations with more than 250,000 inhabitants included in the first round of noise mapping and those with more than 100,000 inhabitants included in the second round, and (ii) the total length of major roads with more than 6 million vehicle passages per year (first round) and more than 3 million vehicle passages per year (second round). The airports are not eligible for noise mapping, as they all (including the Milan Rastislav Štefánik international airport in Bratislava) have far fewer than 50,000 movements per year.

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7 Institute of Hygiene, Faculty of Medicine, Comenius University, Bratislava.
8 Regional Public Health Authority, Bratislava.
9 Public Health Authority of the Slovak Republic, Bratislava.
Table 8. Agglomerations, major roads and railways and major civil airports eligible for strategic noise mapping, Slovakia

<table>
<thead>
<tr>
<th>Source</th>
<th>First round</th>
<th>Second round</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agglomerations (km$^2$):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bratislava</td>
<td>853.2</td>
<td>858.9</td>
</tr>
<tr>
<td>Košice</td>
<td>113.3</td>
<td></td>
</tr>
<tr>
<td>Major roads and highways (km)</td>
<td>518 (238 + 280)</td>
<td>1878</td>
</tr>
<tr>
<td>Major railways (km) + trams (km)</td>
<td>311 + 73</td>
<td>731</td>
</tr>
</tbody>
</table>

Fig. 5. Strategic noise map, Slovakia, first round

Source: Euroakustik (3).

Noise policy and awareness

The Ministry of Health, the Public Health Authority and the 36 regional public health authorities are responsible for dealing with problems of noise pollution according to Act No. 355/2007 Coll. on the protection, promotion and development of public health and Act No. 2/2005 on assessment and control of noise outdoors (including amendments to certain acts). Other ministries, such as the Ministry of Agriculture, Environment and Regional Development, the Ministry of Education, the Ministry of the Interior and the Ministry of Transport, Posts and Telecommunications, are partly involved in environmental noise measurements and management.

The National Reference Centre for Noise and Vibration has been set up by the Ministry of Health. The role of the Centre is to keep professional contact with the Ministry of Health, the Public Health Authority and the regional public health authorities on the problems of environmental and occupational noise and vibration assessment, and with nongovernmental organizations such as the Slovak Acoustical Society, the Slovak National Accreditation Service, the Technical Testing Institute in Piešťany and the Slovak Metrological Institute.
The National Reference Centre has the following functions:

- provision of technical and methodological guidance to the regional public health authorities, which are responsible for the assessment of noise and vibration in the environment and occupational settings;
- preparation of training materials for the Chief Hygienist;
- preparation of proposals for measures to protect public health from noise and vibration;
- training for workers in the field of assessment noise and vibration;
- organization of local educational and scientific events for continuous professional growth;
- assistance with resolving complaints about noise and vibration;
- performance of the tasks associated with the harmonization of existing European legislation;
- provision of consultation for professionals, individuals and entities on noise and vibration.

The Slovak Acoustical Society is a voluntary non-profit-making association of institutions, scientists and technical acousticians, working within the framework of the Slovak Academy of Sciences (6). Founded in 1991 as the Slovak Vibroacoustical Society, it was renamed in 1993. The Society encourages acoustic research and technical practice and organizes the international acoustic conferences well-known in the European acoustic community.

The regional public health authorities are generally responsible for objectively evaluating complaints from the public. They can professionally and responsibly identify and evaluate noise sources. When noise exceeds the acceptable levels laid down in Decree No. 549/2007 Coll. they can take action and enforce sanctions. Sometimes it is difficult to handle complaints about noise generated by individuals or public events at night. In these situations, the cooperation of the local police equipped with simple noise measurement instruments is welcome.

According to Act No. 355/2007 Coll., qualified persons and accredited companies participate in the evaluation of noise exposure for the purpose of developing strategic noise maps and making environmental impact assessments in cases of intervention in the environment. They act under the supervision of the Slovak National Accreditation Service, the Ministry of Health and the National Reference Centre for Noise and Vibration.

**Noise legislation**

Previous long-standing legislation (such as Decree of the Ministry of Health No. 14/1977 Coll. on health protection against adverse effects of noise and vibration, later replaced by Government Ordinance No. 40/2002 Coll. on health protection against noise and vibration) has been replaced by new legislation in Slovakia, as in other new EU member states.

Acceptable noise levels are laid down in Ministry of Health Decree No. 549/2007 Coll., which sets out details of the allowable values and requirements for the objective assessment of noise, infrasound and vibration.

The END has been integrated into national legislation by Act No. 2/2005. WHO’s Guidelines for community noise in specific environments have also been implemented (7).
Strategic noise maps and action plans

In 2007, the first phase of strategic noise mapping was completed, covering Bratislava and the surrounding areas with major roads carrying more than six million vehicles a year. It was estimated that around 480,600 inhabitants from the surrounding areas were exposed to transport noise in the vicinity of roads and highways, while 268,400 inhabitants of the Bratislava urban area (nearly 50%) were exposed to noise exceeding action levels of the indicator $L_{dn} = 60$ dB from traffic on roads and highways. This also applied to rail and industrial sources. The second phase of the strategic noise map will be drawn up by 30 June 2012 in both these areas as well as the Košice urban area and surrounding areas traversed by major roads carrying more than three million vehicles per year.

Following the strategic noise mapping, the responsible authorities developed action plans for protection against noise in areas around major highways, expressways and first-class roads. Information on strategic noise maps and on action plans has been sent to the EC.

There remains a problem, however, with the financing of the action plan in the Bratislava urban area. Information from strategic noise maps and action plans are available on the Euroakustik company’s web site (3).

There is no specialized facility for strategic noise mapping.

Awareness of noise as a public health problem

According to Act No. 355/2007 Coll., the issue of noise and vibration falls under the Ministry of Health and the national and regional public health authorities responsible for dealing with problems of noise pollution.

There have been new challenges for public health experts, environmentalists, technicians and politicians in the identification of the noise problem, environmental noise assessments, noise control options, and decisions about and operation and evaluation of noise regulations.

Workers at public health authorities address the situation regarding exposure to noise in daily life and in the occupational environment (complaints from the public, risky workplaces, occupational diseases and so on). Some of the most common complaints on the agenda of regional public health authorities are those about noise.

According to Act No. 355/2007 Coll., persons (individuals, entrepreneurs or legal persons) using or operating equipment giving rise to noise are required to ensure that the exposure of inhabitants and their environment to the noise is as low as possible and does not exceed permissible values. They have to ensure that the evaluation of noise, infrasound and vibration is carried out every year. In the design, construction or substantial reconstruction of the transport infrastructure, the associated noise in the external or internal environments should not exceed the value of the anticipated traffic load. In the design, construction or substantial renovation of buildings, protection of their indoor environment must be ensured against noise from outside without their other necessary properties being jeopardized. Municipalities are entitled to evaluate exposure to environmental noise and vibration, although such evaluations can only be carried out by persons professionally authorized by the Ministry of Health.
Noise exposure data

Data based on strategic noise maps (number and percentage of people exposed to 55 dBA in major agglomerations, and around major roads, railways and airports) are presented in Tables 9-11 and in Figs. 6 and 7 (3). Data on noise exposure from major roads and railways outside urban areas are accessible on the Noise Observation and Information Service for Europe – NOISE web site (8).

Table 9. Number of flat-dwellers exposed to noise from roads in urban areas, Slovakia, 2006

<table>
<thead>
<tr>
<th>Band values L (dB)</th>
<th>No. of flat-dwellers exposed to band values L_{den}</th>
<th>No. of flat-dwellers exposed to band values L_{night}</th>
<th>No. of people in flats with quiet facades exposed to band values L_{den}</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>2 500</td>
<td>96 900</td>
<td>0</td>
</tr>
<tr>
<td>50–54</td>
<td>16 100</td>
<td>161 400</td>
<td>100</td>
</tr>
<tr>
<td>55–59</td>
<td>93 900</td>
<td>139 100</td>
<td>1 300</td>
</tr>
<tr>
<td>60–64</td>
<td>165 400</td>
<td>94 100</td>
<td>5 200</td>
</tr>
<tr>
<td>65–69</td>
<td>144 900</td>
<td>38 900</td>
<td>15 000</td>
</tr>
<tr>
<td>70–74</td>
<td>83 100</td>
<td>3 700</td>
<td>21 700</td>
</tr>
<tr>
<td>&gt;75</td>
<td>40 500</td>
<td>2 200</td>
<td>25 300</td>
</tr>
</tbody>
</table>

Fig. 6. Number of flat-dwellers exposed to band values <50 – >75 L_{den} (dB) from roads in urban areas, Slovakia, 2006

Table 10. Number of flat-dwellers exposed to noise from major railways and trams in urban areas, Slovakia, 2006

<table>
<thead>
<tr>
<th>Band values L_{night} (dB)</th>
<th>No. of flat-dwellers exposed to band values L_{den}</th>
<th>No. of flat-dwellers exposed to band values L_{night}</th>
<th>No. of people in flats with quiet facades exposed to band values L_{den}</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>215 200</td>
<td>355 600</td>
<td>16 400</td>
</tr>
<tr>
<td>50–54</td>
<td>109 700</td>
<td>92 300</td>
<td>12 800</td>
</tr>
<tr>
<td>55–59</td>
<td>95 100</td>
<td>54 200</td>
<td>14 000</td>
</tr>
<tr>
<td>60–64</td>
<td>67 600</td>
<td>32 900</td>
<td>14 200</td>
</tr>
<tr>
<td>65–69</td>
<td>38 500</td>
<td>8 700</td>
<td>10 200</td>
</tr>
<tr>
<td>70–74</td>
<td>16 600</td>
<td>2 200</td>
<td>6 300</td>
</tr>
<tr>
<td>&gt;75</td>
<td>3 700</td>
<td>400</td>
<td>100</td>
</tr>
</tbody>
</table>
Fig. 7. Number of flat-dwellers exposed to band values $L_{\text{den}}$ (dB) from major railways and trams in urban areas, Slovakia, 2006

Table 11. Number of flat-dwellers exposed to noise from Milan Rastislav Štefánik airport, Bratislava, 2006

<table>
<thead>
<tr>
<th>Band values $L_{\text{night}}$ (dB)</th>
<th>No. of flat-dwellers exposed to band values $L_{\text{den}}$</th>
<th>No. of flat-dwellers exposed to band values $L_{\text{night}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>541 700</td>
<td>544 700</td>
</tr>
<tr>
<td>50-54</td>
<td>2 500</td>
<td>1 500</td>
</tr>
<tr>
<td>55-59</td>
<td>1 600</td>
<td>100</td>
</tr>
<tr>
<td>60-64</td>
<td>500</td>
<td>0</td>
</tr>
<tr>
<td>65-69</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>70-74</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&gt;75</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Data based on local noise measurements

Monitoring of the public noise load was not carried out systematically before the strategic noise mapping took place. Results are, however, available from monitoring activities carried out at random sites, as part of investigations and following public complaints.

According to the 1999 statistics on noise pollution, monitoring was carried out in 63 towns and villages with a total of 1 627 306 people monitored (Table 12) (9).

Table 12. Population affected by road and railway traffic noise based on the equivalent noise levels ($L_{\text{Aeq}}$) excess in dBA, 1999 (%)

<table>
<thead>
<tr>
<th>Noise level (dBA)</th>
<th>Population affected by road traffic noise (%)</th>
<th>Population affected by rail traffic noise (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;55</td>
<td>19.33</td>
<td>0.10</td>
</tr>
<tr>
<td>&gt;60</td>
<td>12.87</td>
<td>1.27</td>
</tr>
<tr>
<td>&gt;65</td>
<td>6.15</td>
<td>1.26</td>
</tr>
<tr>
<td>&gt;70</td>
<td>1.31</td>
<td>0.46</td>
</tr>
<tr>
<td>&gt;75</td>
<td>0.13</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Source: Public Health Institute (9).
Fig. 8 shows the number of people affected by road traffic noise in 2003, based on the equivalent noise levels excess in $\text{L}_{\text{Aeq}}$ (dBA), out of the 2,351,379 people monitored (10).

![Fig. 8. Number of people affected by road traffic noise, Slovakia, 2003](image)

Source: Public Health Institute (10).

In 2007, the first phase of strategic noise mapping yielded some valid data on the Bratislava urban area and surrounding areas traversed by major roads carrying more than six million vehicles per year.

**Research on noise and health**

Research studies have been published since the 1970s in national and international journals about environmental noise exposure and annoyance in Bratislava and other Slovakian towns. Epidemiological studies on environmental noise, annoyance and non-auditory health effects (cardiovascular diseases) have recently been published in peer-reviewed journals. The research studies on noise and health are mostly cross-sectional. There is no specific research on sleep disturbance. Slovakia has not been involved in the collaborative pan-European studies carried out so far.

Reviews of the most important research studies on noise annoyance and cardiovascular noise effects are presented in Tables 13 and 14.

**Needs for knowledge transfer and capacity-building**

The Slovak Environmental Agency represents Slovakia as the direct partner of the EEA and serves as the national focal point. The Agency also has the task of operating the national node of the EIONET. There is a Slovak representative in ENNAH (at the Institute of Hygiene, Faculty of Medicine, Comenius University, Bratislava). Officially collaboration comes about mainly through the EIONET national reference centres for noise and participation in the Regulatory Noise Committee of the EC Directorate-General for the Environment and specialized bodies such as the Technical Committee for CNOSSOS-EU.
The following needs have been identified in the area of knowledge transfer and capacity-building:

- continuing efforts to understand community noise and its effects on health and to improve the scientific basis for policy-making and noise management, with the aim of protecting and improving public health as regards the effects of community noise pollution;
- the support and establishment of specialized departments in relation to strategic noise maps;
- development of continuous monitoring systems for direct health effects in critical locations together with air pollution monitoring;
- development of a global noise impact monitoring study to obtain data on the health effects on communities of various types of environmental noise;
- a solution to the problem of financing for the action plan areas in the Bratislava urban area;
- inclusion of Slovakia in future collaborative pan-European studies;
- studies to assess the effectiveness of noise policies in maintaining and improving soundscapes and reducing human exposure, as well as research related to direct and/or long-term health effects (identification of potential risk groups and sensitive individuals and people with particular health problems; people dealing with complex cognitive tasks; the blind; the hearing-impaired; young children and the elderly; sensitive risk groups; sensitive areas and combined exposures).

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### Table 13. Characteristics of research studies on noise annoyance, Slovakia

<table>
<thead>
<tr>
<th>Location, town</th>
<th>Reference</th>
<th>Aim</th>
<th>Method</th>
<th>Sample</th>
<th>Exposure assessment a</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>General population, Slovakia (as part of Czecho-slovakia)</td>
<td>Radulov &amp; Rolny (11)</td>
<td>To assess environmental noise in selected towns, prepare noise maps, assess noise annoyance</td>
<td>Social survey</td>
<td>Population of 20 towns; 694 measuring stations; 1 400 038 inhabitants</td>
<td>(O) Mean equivalent 24-hour noise levels, traffic noise index, noise pollution level</td>
<td>Limit level for $L_{Aeq}$ was exceeded in 92.36% of measuring stations; 36.4% of inhabitants lived with excess noise</td>
</tr>
<tr>
<td>Bratislava urban area</td>
<td>Ághová et al. (12)</td>
<td>To prepare Bratislava noise maps and assess noise annoyance</td>
<td>Cross-sectional study</td>
<td>Sample of 764 inhabitants in Bratislava urban area</td>
<td>(O) Mean equivalent 24-hour noise levels in 257 measuring stations</td>
<td>68% of measuring stations exceeded $L_{Aeq}$ 65 dBA; noise annoyance in 49.6% of the population exposed to &gt;50 dBA</td>
</tr>
<tr>
<td>Student residence and residential areas, Bratislava</td>
<td>Sobotova et al. (13)</td>
<td>To compare two noise annoyance surveys carried out at a 10-year interval</td>
<td>Comparison of two cross-sectional studies</td>
<td>University students ($n_1=511$; $n_2=857$); exposed and control areas</td>
<td>(O) Mean 24-hour equivalent noise levels</td>
<td>Increase in traffic noise load as well as subjective response to it during 10-year interval</td>
</tr>
<tr>
<td>General population, Slovakia</td>
<td>Dostál et al. (14)</td>
<td>To assess noise in flats and annoyance</td>
<td>Two cross-sectional studies</td>
<td>Sample of 671 and 578 respondents, respectively, aged over 18 years</td>
<td>(O) Maximum noise levels in flats</td>
<td>Important other noise sources (such as footstep noise); 36% of the inhabitants were annoyed</td>
</tr>
</tbody>
</table>

a $O=$objective (noise level outdoors). $S=$subjective (annoyance).
### Table 14. Characteristics of the research studies on cardiovascular effects of noise, Slovakia

<table>
<thead>
<tr>
<th>Location, town</th>
<th>Reference</th>
<th>Aim</th>
<th>Type of study</th>
<th>Sample</th>
<th>Exposure assessmenta</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model laboratory experiment, Bratislava</td>
<td>Lipková &amp; Liška (15)</td>
<td>To evaluate the effect of general noise and psychological load on vegetative functions, basic skin resistance, heart rate in children</td>
<td>Experimental study</td>
<td>Experimental group of 24 children aged 10–11 years</td>
<td>(O) Exposure to school noise of 85 dB from tape recorder (S) Psychological tests</td>
<td>The general load affected heart rate and skin resistance significantly; it was not possible to separate the effect of noise alone</td>
</tr>
<tr>
<td>Hospital, Bratislava</td>
<td>Jurkovičová &amp; Aghova (16)</td>
<td>To evaluate noise levels inside incubators during the care of low-birth-weight newborns; to evaluate the cardiovascular effects (blood pressure, heart rate) of two types of noise</td>
<td>Experimental study</td>
<td>30 low-birth-weight newborns in incubators</td>
<td>(O) Mean 24-hour equivalent noise levels inside incubator, octave analysis</td>
<td>Mean noise levels were 64.2–79.7 dBA up to 500 Hz; heart rate and blood pressure increased after noise stimuli</td>
</tr>
<tr>
<td>Kindergarten, Bratislava</td>
<td>Regecova &amp; Kellerova (17)</td>
<td>To investigate the association between exposure to traffic noise and blood pressure</td>
<td>Cross-sectional study; comparison of kindergartens and residential areas</td>
<td>1542 preschool children in kindergartens (501 males, 741 females) aged 3–7 years, living in Bratislava for more than three years</td>
<td>(O) Weighted average sound pressure levels measured for 24 hours</td>
<td>Urban traffic noise near kindergartens is associated with high mean systolic blood pressure and diastolic blood pressure in preschool children</td>
</tr>
<tr>
<td>Student residence and residential areas, Bratislava</td>
<td>Sobotova et al. (18)</td>
<td>To investigate the relationship between road traffic noise and cardiovascular risk</td>
<td>Cross-sectional study</td>
<td>659 university students, exposed and control areas</td>
<td>(O) Mean 24-hour equivalent noise levels (S) Noise annoyance questionnaire with five-grade scale</td>
<td>Cardiovascular risk score is significantly associated with road traffic noise exposure</td>
</tr>
</tbody>
</table>

*a=objective (noise level outdoors). S=subjective (annoyance).*

### Conclusion

In contrast to some other environmental problems, noise pollution continues to increase, with a growing number of complaints from the exposed population. To improve the situation in environmental noise management, local planning or zoning of residential areas needs to be improved, and prevention and protection against noise should be included at the planning phase and in the costs of new constructions. Realistic action plans should be drawn up to reduce population exposure to noise, based on knowledge of problem areas. These should encourage programmes for science and applied research, practical teamwork among physicians, engineers and professionals and international collaboration.
References


Noise as a public health problem in Slovenia

Sonja Jeram,10 Lilijana Kuhelj,10 Jasmina Karba10

Introduction

Slovenia has an area of 20 273 km² and a population of 2 040 788 inhabitants, an average of 101 inhabitants per km². The capital city, Ljubljana, covers 275 km² with a population of 266 251. Maribor is the second biggest city with 151 349 citizens. Ljubljana and Maribor are the only cities with more than 100 000 inhabitants.

In 2004, the END was integrated into national legislation. In line with its provisions, strategic noise maps were prepared for Ljubljana agglomeration, 462 km of main roads and 67 km of railways (Table 15). The roads and railways included in the second round of mapping will be identified on the basis of a traffic evaluation in 2011. The airports will probably not be included in the second round because of the low frequency of flights.

Table 15. Strategic noise maps, first round of mapping, Slovenia

<table>
<thead>
<tr>
<th>Source</th>
<th>First round</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agglomerations (km²): Ljubljana</td>
<td>275</td>
</tr>
<tr>
<td>Main airport: Ljubljana Airport</td>
<td>No</td>
</tr>
<tr>
<td>Main roads (km)</td>
<td>462</td>
</tr>
<tr>
<td>Main railways (km)</td>
<td>67</td>
</tr>
</tbody>
</table>

Strategic noise maps

Detailed strategic noise maps are available to the public on the internet as part of the Environmental Atlas (1). General information is available on the Slovenian Environmental Agency website (2). Strategic maps are presented in Figs. 9-14.

Noise policy and awareness

The END was integrated into national legislation in 2004 (3). The responsible authority is the Ministry of the Environment and Spatial Planning, which works in collaboration with the Environmental Agency, the municipalities and the Ministries of Transport and of Health.

Several authorities have noise and health as part of their remit in the broadest sense: the Ministry of Health, the National Institute of Public Health, the regional public health institutes, the Institute of Occupational Safety, the Clinical Institute for Occupational, Traffic and Sports Medicine, the Audiological Clinic of the Department of Otorhinolaryngology and Neck Surgery and the Laboratory for Sleep Disorders Treatment at the University Medical Centre.

10 National Institute of Public Health, Ljubljana.
Fig. 9. Strategic noise map ($L_{den}$) for all roads in Ljubljana, 2006

Source: Slovenian Environmental Agency (2).

Fig. 10. Strategic noise map ($L_{den}$) for main roads in Ljubljana, 2006

Source: Slovenian Environmental Agency (2).
Fig. 11. Strategic noise map ($L_{den}$) for railways in Ljubljana, 2006

Source: Slovenian Environmental Agency (2).

Fig. 12. Strategic noise map ($L_{den}$) for industry in Ljubljana, 2006

Source: Slovenian Environmental Agency (2).
Fig. 13. Strategic noise map ($L_{den}$) for main roads in Slovenia, 2006

Source: Slovenian Environmental Agency (2).

Fig. 14. Strategic noise map ($L_{den}$) for main railway in Slovenia, 2006

Source: Slovenian Environmental Agency (2).
Environmental noise and public health fall under the Ministry of Health and the National Institute of Public Health.

Several institutions are authorized to take noise exposure measurements. Statutory supervision according to the rules on initial assessment of noise and operational monitoring for sources of noise is exercised by five regional public health institutes and two institutes for occupational safety. Sixteen private companies and other institutions are also authorized by the national accreditation body to take measurements of environmental noise (2).

Four laboratories are authorized to make noise exposure assessments based on model calculations, two in the regional public health institutes and two in the institutes for occupational safety. Eight private companies and other institutions are also certified by the national accreditation body (2).

**Noise legislation**

The principal act regulating environmental noise is the Decree on the Assessment and Management of Environmental Noise 121/2004, adopted on the basis of paragraphs 1 and 2 of Article 23 of the Environmental Protection Act on environmental quality standards:

1. The Government shall lay down environmental quality standards, alert and critical values, pollution reduction levels and related measures taking into account potential effects of the total and of integral environmental burdens.

2. The Government shall also lay down the criteria for sensitivity, vulnerability or the level of burden on the environment on the basis of which environmental components or particular areas shall be classified into classes or degrees. New activities on these environmental components or particular areas shall be permitted only when they do not downgrade the classification of the environmental component or area into a particular class or degree.


**Strategic noise maps and action plans**

The Ministry of the Environment and Spatial Planning is responsible for providing strategic noise maps in accordance with the END. The requirements of the END for strategic noise mapping were met in the period 2005–2009 (1,2,4,5).

The Ministry also coordinates activities under the action plan in collaboration with the Ministries of Health and of Transport and responsible municipalities. In 2010, a working group of 18 members from responsible institutions, municipalities and companies providing exposure data was established to prepare for the action plan. The action plan for roads and railways outside agglomerations was finished in 2011 (6).
Awareness of noise as a public health problem

The Ministry of Health is responsible for raising awareness concerning the environmental noise hazard. The National Institute of Public Health and nine regional institutes of public health are organized in a network and together involved in activities for raising awareness about noise and its adverse effects on health. Several lectures were given to teachers in primary and secondary schools in all regions in 2010, a web site was established with a contact address for public questions, contact was established with the media, and information about environmental noise and health was promulgated through television, radio and the newspapers (7).

Noise exposure data

Tables 16 and 17 present data on the evaluation of population exposure based on strategic noise maps.

Table 16. Exposure to day-time environmental noise of $L_{den} > 55$ dB, Slovenia, 2006

<table>
<thead>
<tr>
<th>Source</th>
<th>Area</th>
<th>Population exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agglomeration – Ljubljana:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- roads*</td>
<td>30%</td>
<td>168 696 (63.38%)</td>
</tr>
<tr>
<td>- railways</td>
<td></td>
<td>11 326 (4.26%)</td>
</tr>
<tr>
<td>- industry</td>
<td></td>
<td>406 (0.15%)</td>
</tr>
<tr>
<td>Main airports</td>
<td>Not estimated</td>
<td>Not estimated</td>
</tr>
<tr>
<td>Main roads</td>
<td>410.81 km²</td>
<td>136 363</td>
</tr>
<tr>
<td>Main railways</td>
<td>51.7 km²</td>
<td>10 051</td>
</tr>
</tbody>
</table>

* 100% of the area of the strategic noise map for Ljubljana is 275 km².

Table 17. Exposure to night-time environmental noise $L_n > 50$ dB, Slovenia, 2006

<table>
<thead>
<tr>
<th>Source</th>
<th>Area</th>
<th>Population exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agglomeration – Ljubljana:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- roads*</td>
<td>20%</td>
<td>113 945 (42.8%)</td>
</tr>
<tr>
<td>- railways</td>
<td></td>
<td>8 832 (3.31%)</td>
</tr>
<tr>
<td>- industry</td>
<td></td>
<td>233 (0.09%)</td>
</tr>
<tr>
<td>Main airports</td>
<td>Not estimated</td>
<td>Not estimated</td>
</tr>
<tr>
<td>Main roads</td>
<td>Not estimated</td>
<td>85 781</td>
</tr>
<tr>
<td>Main railways</td>
<td>Not estimated</td>
<td>8 691</td>
</tr>
</tbody>
</table>

* 100% of the area of the strategic noise map for Ljubljana is 275 km².

During the day, 168 696 inhabitants of Ljubljana are exposed to $L_{den}$ above 55 dBA from road traffic noise. Fewer people are exposed to railway and industrial noise: 11 326 and 406, respectively. About 30% of the area evaluated for road traffic noise falls in the zone of $L_{den} > 55$ dBA (Table 16).

At night 113 945 people are exposed to a noise level of $L_n > 50$ dBA from road traffic noise; 8832 and 233 people are exposed to railway and industrial noise, respectively; and 20% of the area evaluated for road traffic noise falls into the zone of noise level $L_{den} > 50$ dBA (Table 17).
Strategic noise maps for Ljubljana show that almost 65% of the population is exposed to a noise level of $L_{den} > 55$ dBA during the day and almost 45% is exposed to a noise level of $L_{den} > 50$ dBA at night.

Strategic noise maps for the main roads show that 136,363 people are exposed to noise of $L_{den} > 55$ dBA. Over 10 times fewer (10,051) are exposed to the same level of noise from railway traffic (Table 16). At night, 85,781 and 8,691 people are exposed to noise of $L_{den} > 50$ dBA from road and railway traffic, respectively (Table 17).

It has been estimated that 410.81 km$^2$ of roads and 51.7 km$^2$ of railways emit a noise level of $L_{den} > 55$ dBA.

*Data based on local noise measurements and model calculations*

Measurements are mainly performed for the purpose of operational monitoring, land use planning and dealing with complaints and for comparison with evaluations in noise maps. For environmental impact assessment, exposure to noise is predicted with modelling.

*Research on noise and health*

No comprehensive epidemiological study concerning the adverse effects of environmental noise on the health and well-being of the population has been carried out. Some data are available from public surveys presenting public opinion regarding noise (8,9). A few studies have been carried out in schools evaluating the impact of noise on children’s efficacy at work (10–15).

*Needs for knowledge transfer and capacity-building*

Assistance is needed with: (i) education in the effects of environmental noise on health, (ii) the carrying out of epidemiological studies in this field, and (iii) education and human resources, to establish a team to carry out impact assessments and evaluation of the environmental burden of disease related to noise.

There is a need to establish and consolidate collaboration with important international organizations such as the EC, ENNAH, ICBEN and WHO. Continuation of participation in ENNAH or similar networks and/or research projects would be of great importance.

*Conclusions*

The following conclusions can be drawn about the status of environmental noise management in Slovenia:

- the END has been implemented and an action plan for environmental noise abatement is being prepared;
- there are good human and technical resources for environmental noise assessment and mapping;
- a network has been established through public health institutions and schools to raise awareness about the effects of noise on health, especially among young people using mobile music devices;
- education and human resources are needed to establish a team for impact assessment and evaluation of the environmental burden of disease;
• involvement in the ENNAH FP7 network on noise and health represents a possibility for education and establishing contacts;
• greater involvement is needed in international organizations and research projects.

References

15. Kacjan Žgajnar K et al. Noise as risk factor for teachers in kindergartens. Ljubljana, University of Ljubljana, Faculty of Health Science, 2009:103-110.
Noise as a public health problem in the former Yugoslav Republic of Macedonia

Gordana Ristovska,11 Dragan Gjorgiev11

Introduction

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 km², and the estimated population is 2 061 315 with a density of 82.2 per km². The capital is Skopje, with 506 926 inhabitants according to a 2002 census. The second largest city is Kumanovo, with 105 000 citizens, then Bitola with 95 000 inhabitants (1).

The road infrastructure is 13 736 km long and the railway network is 900 km. The two large pan-European corridors (corridor 8 running east-west and corridor 10 running north-south) are currently being upgraded. There are two international airports, in Skopje and Ohrid, with regular direct connections to several larger European transport centres (1).

A questionnaire-based survey has shown that in Skopje, the most annoying sources of noise are traffic, neighbourhood activities and construction activities.

Noise policy and awareness

Management of environmental noise is regulated by the Law on Environmental Noise Protection, which is harmonized with the END. This Law identifies noise exposure indicators, the responsible authorities and the preparation of strategic noise maps and action plans.

The authority responsible for collecting data on noise exposure indicators and the percentage of the population exposed to noise is the Ministry of Environment and Physical Planning.

Authorized and accredited laboratories for noise exposure assessment will obtain data for noise exposure indicators in collaboration with responsible bodies (such as the Ministry of Environment and Physical Planning) for the major roads, railways and airports and with local governments for agglomerations and settlements. Laboratories for noise measurements are situated in public health centres and in consultant companies for environmental risk assessments. Some of them are already accredited by the National Accreditation Institute, and others are working on accreditation (1,2).

Strategic noise maps have not yet been prepared, so there are no data about the population exposed to noise and the public has no information about the current status of such exposure. National limit values for the prevention of adverse effects from noise have been established by the Ministry of Health in accordance with WHO recommendations (1,3).

Noise exposure data

There are no data based on strategic noise maps (the number and percentage of people exposed to 55 dBA and more in major agglomerations and around the major roads, railways and airports).

11 Institute of Public Health, Skopje.
Data for noise levels in urban centres such as Bitola, Kumanovo and Skopje are available based on local noise monitoring, but not for the percentage of the exposed population (1,3).

**Research on noise and health**

The Ministry of Health is responsible for the assessment of noise-induced health effects. The Institute of Public Health has developed methods for assessing noise annoyance and sleep disturbance and has carried out a cross-sectional study of adverse health effects in Skopje.

In 2002, a cross-sectional study was made to assess the noise exposure of schoolchildren and psychosocial effects in exposed children in Skopje. An association was found between chronic noise exposure above $L_{Aeq} > 55$ dBA and reduced social adaptability ($\chi^2 = 10.9; P = 0.0009$) with a relative risk (RR) of 1.39 in the study group. Chronic noise exposure was associated with higher oppositional behaviour ($\chi^2 = 4.16, P < 0.05$) and RR=1.46 for schoolchildren exposed to $L_{Aeq} > 55$ dBA (4).

In 2006-2008, the Institute of Public Health carried out a cross-sectional study and a prospective study for assessment of annoyance and noise-induced health effects in the adult population in Skopje. The cross-sectional study was designed as a questionnaire-based survey, performed in 2006, with the specific aims of determining the noise exposure indicators $L_{day}$, $L_{night}$, $L_{den}$, quantifying annoyance and the sleep disturbance level in adult population, and determining the exposure-response relationship (5).

**Sleep disturbance**

Analysis of the sleep disturbance level in the entire sample showed that 8.24% of subjects reported a high level of sleep disturbance, 17.82% reported moderate sleep disturbance and 74% suffered no sleep disturbance induced by noise. Analysis of the sleep disturbance level according to source of noise showed that the most frequent sources were neighbourhood and road traffic noise (both in about 17% of subjects), construction activities (16%), leisure activities (14.5%), and catering establishments (12%). Railway and aircraft traffic noise did not cause sleep disturbance in subjects (6).

**Annoyance**

Analysis of the annoyance level in the whole sample on a scale of 0 to 10 showed that 13% of subjects reported a high level of annoyance, 33.5% reported a moderate level of annoyance and 53% felt no annoyance. Analysis showed that most annoyance came from construction activities (in 34% of subjects), a high level of annoyance came from road traffic noise (24%), 18% were annoyed by noise from people gathered in one place, and 17% by noise from restaurants, cafeterias, etc. Annoyance in subjects was associated with hypertension ($P=0.02$), depression ($P=0.00$) and migraine ($P=0.0007$) (5,7).

The prospective study showed that subjects exposed to $L_{day}$ above 65 dBA and $L_{night}$ 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) (5).
Assessment of capacity-building needs for health risk assessment of environmental noise: case studies

Needs for knowledge transfer and capacity-building

Implementation of the END has been delayed due to a lack of resources and the absence of noise from the environmental health and public health agenda. Support is needed for the development of human and technical resources, and for noise mapping and action plans.

A representative of the Institute of Public Health is involved in international research projects such as ENNAH and in the development of guidelines for risk assessment provided by WHO. The country needs to be included in further pan-European research projects on noise and health and projects for assessment of the burden of disease from environmental noise in collaboration with the EC’s Directorate-General for the Environment and Joint Research Centre.

Conclusion

Skopje is the most noise-polluted city in the country. The other cities are showing a tendency towards growth and migration of the rural population towards the urban areas. Small businesses are starting with no measures for protection against noise. Research has shown that exposure to environmental noise has an impact on public health and needs to be given priority in public health policy-making. An estimation of the burden of diseases from environmental noise and a cost-benefit analysis will give additional support to making the need to address noise a public health priority.

References

Conclusion

Environmental noise was mentioned as a priority in the Parma Declaration, adopted at the Fifth Ministerial Conference on Environment and Health in March 2010. There is, however, a gap in the quality of noise exposure assessment between old and new EU member states, the south-eastern European countries and the newly independent states. This is the first document to show qualitatively the situation regarding policy and professional capacity relating to noise in Albania, Belarus, the Czech Republic, Georgia, Serbia, Slovakia, Slovenia and the former Yugoslav Republic of Macedonia. In these countries, noise is regarded as a major and growing environmental health and public health problem. Noise mapping and action plans have been carried out in accordance with the END in new EU member states. In Albania, Serbia and the former Yugoslav Republic of Macedonia, noise legislation has been harmonized with END but noise mapping and action plans are still at the planning stage. Belarus and Georgia are preparing to harmonize their national legislation with the END. The following areas of common need for knowledge transfer and capacity-building in the new EU countries, south-eastern European countries and the newly independent states have been identified:

- implementation of the END, especially in the preparation of strategic noise mapping and action plans;
- human resources development through education and training in health risk assessments and burden of diseases stemming from environmental noise;
- methodological guidelines for health risk assessment of environmental noise.

WHO’s European environment and health process, in collaboration with the EC authorities implementing the END (the Directorate-General for the Environment, the Joint Research Centre and the EEA) and involving expert networks (such as ENNAH and ICBEN), has promoted, and will continue to promote, knowledge transfer and capacity-building for environmental noise risk assessment in the Region, particularly in those countries that have the greatest needs.
Assessment of needs for capacity-building for health risk assessment of environmental noise: case studies

A group of international experts met in Bonn in October 2010 to define and agree on the assessment of the burden of disease from environmental noise, with a focus on cardiovascular disorders and sleep disturbance, and to promote knowledge transfer and capacity-building in European countries in the area of health risk assessment of environmental noise. The needs for awareness-raising and capacity-building in new EU member states, south-eastern European countries and newly independent states were studied on the basis of reports of experts from Albania, Belarus, the Czech Republic, Georgia, Serbia, Slovakia, Slovenia and the former Yugoslav Republic of Macedonia. The following common needs were identified: harmonization of the implementation of the Environmental Noise Directive 2002/49/EC, especially for strategic noise mapping and noise action plans, human resources development through education and training in health risk assessment, and provision of methodological guidelines for health risk assessment of environmental noise exposure. WHO, the European Commission and expert networks are important in promoting the transfer of knowledge and building human and institutional capacities for environmental noise risk assessment.