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Environmental noise guidelines implementation in Poland

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ABSTRACT

Directive 2002/49/EC (END) article 6(3) states that "harmful effects may be assessed by means of dose-effect relations referred to in ANNEX III". The dose-effect relations could be used to assess the effect of noise on populations. In particular, it is possible for a given value of noise index, like Lden of a given noise source, to predict the percentage of people who will be highly annoyed by this noise. The WHO environmental noise guidelines document presents the recommended Lden values for five different noise sources which when applied could prevent people from five harmful health effects. The recommendations presented in the WHO guidelines are based on the does-effect relations for high annoyance and high sleep disturbance and on formulas for ischaemic heart disease and stroke. It seems natural that this material could be implemented in the revised version of ANNNEX III in the END. Right now the Noise Committee is working on the new version on ANNEX III and to my knowledge reaction of different members of EU is different. In this presentation I will show how it looks like in Poland.

Keywords: WHO - Noise guidelines, ANNEX III

1. INTRODUCTION

The main purpose of the Environmental Noise Guidelines for the European Region (1) is to provide recommendations for protecting human health from exposure to environmental noise originating from various sound sources. EU Member States agreed that recommendations from these guidelines should be observed in constructing the revision of ANNEX III of the Environmental Noise Directive (END). The recommendations introduced in the working version of ANNEX III (2) refer only to noise produced by three kinds of transportation sources: road traffic, railway and aircraft. The recommended Lden values for these three environmental sound sources could prevent people from specified four harmful health effects: ischaemic heart disease, stroke, high annoyance and high sleep disturbance. Such harmful effects may be assessed by means of dose-effect relations presented in WHO document, as well as, in the ANNEX III (Equations (3) to (20)).

The basic aim of ANNEX III is to define the best assessment method for calculating the number of people affected by noise produced by various transportation sound sources. The proposed methods are quantitative and are designed to calculate separately the number of inhabitants exposed to each of the three kinds of transportation noise. These calculated values can later be ranked according to the relative importance of a particular noise source.

In sum, ANNEX III contains methods allowing to calculate the number of people affected by three noise sources with respect to four harmful effects. However, the guidelines neglect the data informing about the population structure of the considered urban area. Therefore it is not possible to calculate the relationship between the number of affected people and their living conditions. For example, the regulations in ANNEX III do not allow to relate a given place in a city to highly annoyed people exposed to road traffic. Such data are important in constructing an efficient action plan which recommends means to reduce noise in a given area in a city under consideration. The higher the number of highly annoyed people in a given area the more vital is the action towards reduction of noise. Since ANNEX III is still unfinished it should be decided if it should focus on a general or a more specific solution. The first, general approach will consist in proposing methods allowing to calculate the total number of highly annoyed people in a whole city. In such a case, one has to answer the question how these calculations can be used in constructing an efficient action plan? The second, specific approach will demand much more work, but

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would be easier to implement.

2. Methodological problems in a working version of the Annex III document

Before ANNEX III will be established as a law in noise management some important methodological problems should be addressed. I will discuss one of them.

The document assumes that harmful effects of noise causing an increase in the risk of ischaemic heart disease (IHD), as well as an increase in the risk of stroke (STR), can be quantified by the relative risk. This assumption can be presented in the form of the following equation:

$$RR = \frac{P_{event\ when\ exposed}}{P_{event\ when\ not\ exposed}} \tag{1}$$

where RR is the probability of an event occurring (e.g. developing a disease) in an exposed group to the probability of the event occurring in the non-exposed group. The RR values are calculated for each noise source separately.

The calculations of RR for a given harmful effect and noise source require to insert in the equation (1) the specific values of Lden at which risk of IHD or STR starts. An example of such specified equation for the incidence rate of the IHD for road traffic is:

$$RR_{IHD,i,road} \begin{Bmatrix} \exp\big((ln1.08/10) * (L_{den} - 53)\big)\ for\ Lden\ greater\ than\ 53\ dB \\ 1 \qquad for\ Lden\ equal\ or\ smaller\ than\ 53\ dB \end{Bmatrix} \tag{2}$$

Values for another noise sources and harmful effects could be calculated without problems. The problem arises when we want to calculate the number of people affected by given harmful effect caused by particular noise source - $N_{x,y}$. To perform these calculations we need data of incidence rate, L_y and mortality rate, M_y:

$$N_{x,y} = PAF_{x,y,i} * L_y * P \tag{3}$$

$$N_{x,y} = PAF_{x,y,m} * M_y * P \tag{4}$$

where $PAF_{x,y}$ is the population attributable fraction, P is the total population of the area under assessment (the sum of the population in the different noise bands).

These data should be obtained from statistics on health region or country where the area is. However, in some countries (e.g. in Poland) such data are difficult or even not possible to obtain.

This problem does not exist when it comes to two other harmful effects: high annoyance (HA) and high sleep disturbance (HSD). These harmful effects can be quantified by the absolute risk (AR) defined as: "Occurrence of the harmful effect in a population exposed to a specific level of environmental noise". There are well known equations for three different noise sources which can be used for the quantification of high annoyance (HA). An example used for road noise is presented in Eq. 5.

$$AR_{HA,road} = (78{,}9270 - 3{,}1162 * L_{den} +), 0342 * L_{den}^2)/100) \tag{5}$$

Similar equations could be applied to high sleep disturbance (HSD). The example used in calculation of road noise is presented in Eq.6.

$$AR_{HSD,road} = (19{,}4312 - 0{,}9336 * L_{night} + 0{,}02126 * L_{night}^2)/100 \tag{6}$$

For HA and HSD the total number N of people affected by the harmful effect y (number of attributable cases) due to the source x is derived (for each combination of noise source x (road, railway, aircraft) and harmful effect y (HA, HSD)) by the following equation:

$$N_{x,y} = \sum_j (n_j * AR_{j,x,y)}) \tag{7}$$

where $AR_{x,y}$ is the absolute risk of specific harmful effect (HA, HSD) and n_j is the number of people that are exposed to the j-th exposure band of noise.

What needs clarification is the decision which approach to choose: general or specific. What should be calculated: the number of affected people for the whole city or the number for a given area in the city. If the second option would be chosen the question remains how to specify the area studied.

3. The current, legally recommended in Poland, method of calculation of the number of people affected by noise

Noise maps in Poland are calculated for five noise sources separately: tram, railway, road, aircraft and industry noise. In addition, the map for each noise source has several layers with different noise level recommendations. Within each layer the places (expressed in a number of people in a given layer - m) where the recommended Lden value is exceeded are identified. For these places the difference (ΔL) between the actual Lden value and the recommended one is calculated. These parameters are input values for the equation for index M, which is related to the number of people exposed to a given noise source:

$$M = 0{,}1m(10^{0{,}1\Delta L} - 1) \quad (8)$$

The difficulty in calculating index M is that there are no rules how to relate its value to the different areas. As can be seen from equation (8) neither the number of people exposed to a given noise source nor the dose –response relationship for different harmful effects are calculated.

4. Environmental noise guidelines implementation in Poland

In my opinion, the environmental noise guidelines can currently be implemented in Poland in a limited form, only for two harmful effects: high annoyance (HA) and high sleep disturbance (HSD).

To assess the actual number of (HA) or (HSD) people in the studied area it is recommended to use local exposure response function (ERF) (the exposure response function was earlier called dose-response relationship). However, in Poland such data are not available. In such case the generalized ERFs can be applied. The new acoustic map for Poznan constructed along these lines is presently calculated. The final results of these new calculations will be compared to the M values calculated earlier.

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