GENERAL AND/OR LOCAL ASSESSMENT OF THE IMPACT OF TRANSPORTATION NOISE IN ENVIRONMENTAL HEALTH IMPACT STUDIES ?

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ABSTRACT

In environmental health impact studies all severity grades of potential health impact have to be assessed for a local project. This means at least to assess the best documented effects such as annoyance, sleep disturbance and cardiovascular health.

Currently, general exposure-effect-relationships are sufficiently established only for annoyance. The environmental noise directive asks the member states to provide noise maps to arrive at comparable estimates of the noise impact of transportation sources. This challenging task has still to be done without a unified method of effect assessment.

Recently, a new report (RIVM report 630400001/2005) has compiled and assessed further exposure-effect-relationships for sleep and cardiovascular health for use in the Netherlands.

In this report a substantial difference was shown when a survey derived exposure-effect-relationship for sleep disturbance around Schiphol Airport was compared with the standard curve extracted from meta-analysis.

Even more difficulties are to be expected in the field of cardiovascular health and sleep due to a different geo-socio-demographic and health (care) structure across Europe.

In this paper, we present examples from an environmental health impact study of a large transnational rail project, where due to the interaction between alpine topography, climate, major traffic structure and the varying distribution of residential areas small-scale effect variation plays a substantial role. The application of general exposure-effect-relationships may, therefore, lead to over- as well as underestimation of the potential health impact of projects subject to Environmental Health Impact assessments (EHIA).

1   INTRODUCTION

In a common authoritative definition, HIA has been defined as "a combination of procedures, methods and tools by which a policy, program or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population [1]. Thus, the distribution of the effect within the concerned population is a main issue. By using only standard-exposure-effect-curves the assessment runs the potential risk of over- and underestimation of risk, given the differing topographic, climatic, residential, socio-demographic and health (care) structure across Europe. By trying to fulfill another important aim of the assessment, namely to approach the potential of effects, also different grades of severity such health impacts have to be assessed for a local project.

In the noise assessment area, currently, general exposure-effect-relationships for a wider range of transportation noises are sufficiently established only for annoyance.

Only the Government in the Netherlands has recently made some efforts to compile and assess further exposure-effect-relationships for sleep and cardiovascular health to provide guidance for their use in general practice [2]. However, also this report pinpointed to a locally, survey derived exposure-effect-relationship for sleep disturbance around Schiphol Airport which did show a substantial difference when compared with the standard curve extracted from meta-analysis. Others have earlier communicated deviating exposure-effect-relationships [3], [4], [5] and Klaboe et al have recently pointed to neighbourhood soundscape effects as explanatory variable [6]. Fields [7], in his review paper at the ICBEN-conference in Rotterdam, has reminded us that "on the average communities differ with a standard deviation in annoyance responses that is the equivalent of about a 7 decibel difference in noise exposure. And Fields added "it is especially relevant for noise regulations because it identifies communities that might be treated differently in noise regulations" and "There is almost no research (about this), so I will not talk about it".

Within the framework of an environmental health impact assessment of a large transnational rail project we had the opportunity to carry out epidemiological studies to provide local information about exposure-effect-relationships for the assessment.

2   METHODS

2.1   Area and Samples

The studies took place in the Wipp-valley north and south of the Brenner pass. This narrow valley is the major alpine transit-route linking North and South-Europe. Highway, rail track and main road run often close in parallel with changing combination of source exposure. To support the EHIA two surveys were conducted: A representative phone survey (N=2002) and an interview based face to face (ftf) survey (N=2070). A small control-sample (N=442) took part in both surveys for validation of the response information. As a central part of both surveys was indentical a pooled sample was created (N=3630) to get more statistical power in analysis.

2.2   Exposure information

Air pollution and sound-level information for the survey respondents were provided from sophisticated GIS-modelling of the difficult topographic and orographic terrain. With the available soundlevel-information several basic (Lden, Lnight) and derived noise indices (source combinations etc.) were created and linked via GIS to the adress of the participants. The most exposed façade was used for this purpose.

2.3   Annoyance and health information

In both surveys, the ICBEN-core-question for annoyance was asked with an extension for interference with noise in the same format. Due to our previous experience we used the verbal 5 point scale in the phone and the 11 point scale in the ftf-survey.

In both surveys, list of doctor diagnosed diseases and prescribed medications provided the core information on health. A five-item (frequency) sleep scale measured sleep quality independently from noise to avoid bias [8].

Further efforts were made to provide summary health indicators of impact (calculation of DALYs and monetarisation) for the provided project scenarios (status quo, business as usual, project realisation).

2.4   Statistical methods

For the generation of local exposure-effect-curves standard logistic or linear multiple regression techniques was applied from a standard statistical package (S-plus).

In order to make the information between the surveys consistent (5 vs 11-point scale) and for the extraction and comparison of local exposure-effect-relationships with standard information from meta-analyses various standard and alternative methods (fuzzy methods) were used.

3   RESULTS

For a better comparison effect estimates on different levels of health outcomes are shown.

3.1   Annoyance

The exposure-effect-curves provide evidence for a stronger effect of rail noise at higher levels and also evidence for a difference of the effect in the north and south parts of the valley.
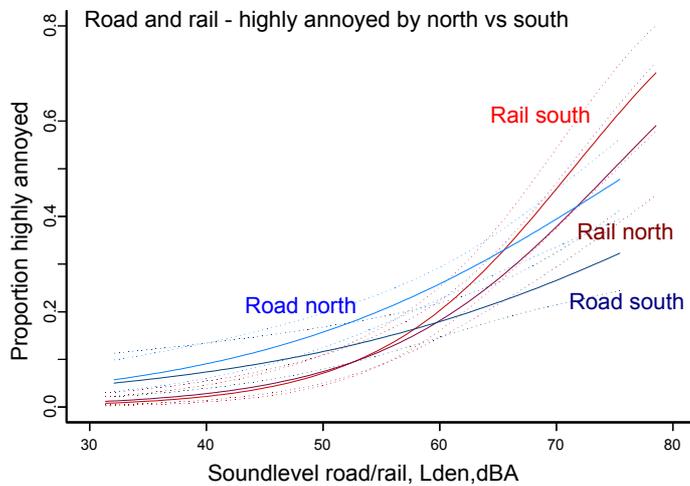
Fig 1. Exposure-effect curve for road and rail sound exposure by area

3.2 Sleep

The exposure-effect-curves for rail and main road differ substantially by area. While in the northern area
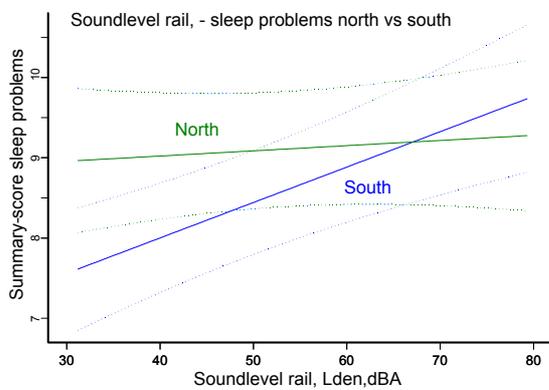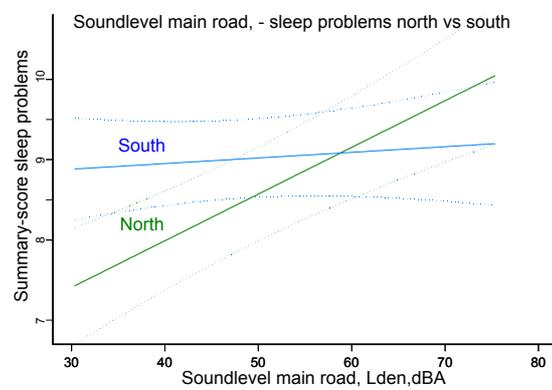

Fig 2. Rail exposure and sleep by area

Fig 3. Main road exposure and sleep by area

3.3 Health

For some of the health endpoints significant exposure-effect relationships were observed. Among the most stable relationships were depression diagnosis and treatment and hypertension and treatment. Also with these health endpoints differences show up by source and area: rail exposure shows a stronger effect on the prevalence of hypertension in the southern part, while main road exposure exhibits stronger effects in the northern part. These

differences are not fully statistically significant but they may be relevant for public health and policy.
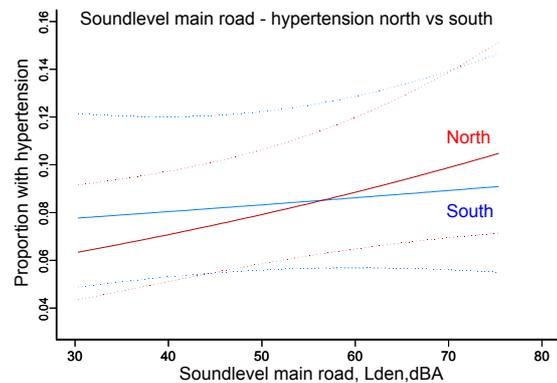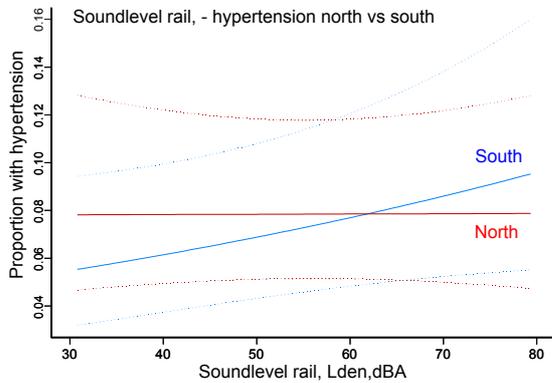

Fig 4. Rail exposure - hypertension by area   Fig 5. Main road exposure - hypertension by area

Doctor diagnosed depression prevalence does not show a significant relation with rail noise, a just significant one with combined road and the strongest with exposure to all three sources. To show the importance of modifiers both exposure-effect relationships are broken down by health status. Those in average or worse health show a steeper increase starting around 65 Lden.
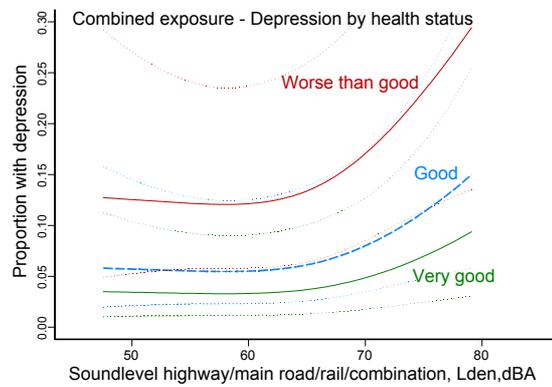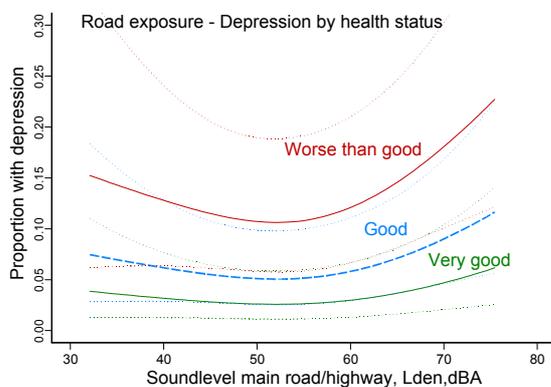

Fig 6. Road noise - depression by health   Fig 7. Combined exposure - depression by health

4   SUMMARY

The results obtained in two larger surveys in the framework of a EHIA provide evidence for significant differences by area and by source, that would not be expected by applying general exposure-effect-curves. These local effect-curves provide valuable extra-information

for public health and policy to make accurate decisions about needed measures to combat noise in the right place and to abate noise from the right source.

   Progress has been made across Europe in incorporating EHIA into routine practice at local level. However, the evidence base and the methods have to be improved to serve both local and general needs in public health and policy [9]. The recent publications from central public health institutions in the Netherlands [2] and Germany [10] are steps to be followed up further. Because the decisive question is "Do we want modeling exposure or understanding effects" as Susan Staples has eloquently made her point [11].

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EURoNoiSE 2006

30 May - 1 June 2006 Tampere, Finland

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