

# ROAD TRAFFIC NOISE EXPOSURE AND MYOCARDIAL INFARCTION

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**Introduction** Noise is an environmental factor of increasing importance for human health. In urban areas traffic noise is often the dominating source of exposure and steadily increasing (1). In Sweden more than 2 million inhabitants are exposed to traffic noise levels exceeding 55 dBA Leq 24hr, which is the present national guideline value (2). Approximately one third of these persons are annoyed by noise outside or near their homes at least once a week (3). Disturbances due to noise exposure are commonly described. Traffic noise has been linked to various psychological and physiological effects. Common psychosocial responses are sleep disturbances, interference with daily activities and general annoyance. Some epidemiological studies of long term traffic noise exposure have indicated an increased risk for ischemic heart disease and hypertension (4-7). However the evidence is still conflicting.

In a review Babisch (8) reports that there is at present little epidemiological support for an increased risk for hypertension in traffic noise exposed subjects. Regarding ischemic heart disease there is some evidence of an increased risk (8)). In total there are approximately 20 epidemiological investigations published regarding long-term cardiovascular effects of traffic noise. Most of these studies have a cross-sectional design without knowledge regarding the duration of exposure. In addition comprehensive studies of health effects due to combined noise sources in the three large areas of transport; road, rail and aircraft, are missing. Other common weaknesses are rough exposure assessments especially on individual levels as well as incomplete control of potential confounders and non-standardised measurements of blood pressure. Further epidemiological studies taking these problems into account are thus needed.

Our objective was to study the risk for myocardial infarction at long time residential traffic noise exposure with refined epidemiological methods. To control for potential risk factors a large Swedish population based case-control study (SHEEP- Stockholm Heart Epidemiology Program) of first time myocardial infarction was used for the investigation. A tool for exposure assessment on an individual basis was also to be refined.

## Subjects and Methods

**Study Subjects** The SHEEP study has been described in detail elsewhere (9). In brief the study comprised all nonfatal and fatal first events of myocardial infarction (MI) among Swedish citizens age 45-70 years, who were resided in Stockholm county during 1992-1993 (1992-1994 for women) and population controls from the corresponding study base. The diagnostic criteria for MI used to determine case inclusion were those applied by the Swedish Association of Cardiologists (10). In total, the SHEEP study included 2,246 cases and 3,206 controls. Extensive information on a large set of potential risk factors for MI was collected in a questionnaire and in a complementary telephone interview. Criteria for categorisation of different risk factors are described in detail elsewhere (11). The present study on road traffic noise and myocardial infarction, finally comprised 3,575 subjects, 1,538 cases and 2,037 referents after special exclusion criteria mainly regarding residential time.

*Noise Exposure Assessment* Assessments of noise exposure levels shall be performed manually for all home addresses among the study subjects from 1970 to 1992/1994, when the subjects became included in the SHEEP study. In total approximately 7.500 addresses will be analysed.

A simplification of a Nordic prediction model for road traffic noise is used for calculation of road traffic related noise exposure (12). Help of a similar model calculates exposure to railway traffic (13). Aircraft noise is assessed for individual addresses using well-established computer based program on aircraft statistics (14,15).

Exposure assessments for road traffic noise at individual addresses can in the simplified model be calculated using information about number of vehicles/24hr and speed. Information about distances from roads, and angles between the dominating noise exposed façade of the residence and main roads are also needed. Noise barriers are also accounted for in the calculations. Local maps, scale 1:4000, make it possible to detect separate houses and measure angles and distances to relevant roads (figure 1). Traffic count has to be matched to the period of residence.

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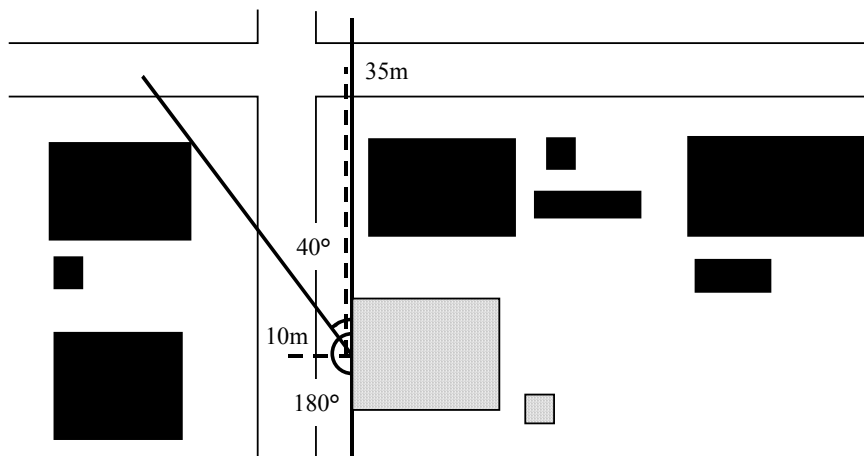


Figure 1: A typical example of exposure assessment. The residents in the grey house are exposed to two main roads for which angles (solid lines) and distances (dashed lines) are calculated.

*Questionnaire* To refine exposure assessments and reduce exposure misclassification additional residential data is needed. For that reason a new questionnaire has been constructed. Information will be collected regarding orientation of living rooms, bedrooms and window opening habits. To better estimate the potential influence of noise sensitivity and attitudes towards noise relevant questions in this respect are included in the questionnaire.

To control for work related noise there are some questions regarding noise conditions at all working places between 1970-1992/1994. Some questions regarding problems with noise related to work and strategies for coping are also included.

**Results** Hitherto noise exposure has been calculated for about 1.500 addresses. To validate the method interim comparisons will be performed with the results from two other recent exposure studies in the county of Stockholm. In both these studies the complete Nordic prediction model has been used for extensive digital noise mapping. In one of these investigations a database regarding noise exposure ( $Leq\ 24\ hr > 59\ dBA$ ) has been created for the whole city of

Stockholm. Altogether 8.000 addresses have been registered and noise exposure has been assessed in detail for each individual façade. These results are soon to be published. The other study is a pilot project of noise exposure in Huddinge, a municipality in Stockholm county with 70.000 inhabitants and a lot of different transportation noise, and in Södermalm, a district in the inner part of the city of Stockholm with nearly 100.000 inhabitants. In this study a tool for digital noise mapping of the total area has been evaluated. Beside road traffic noise, which is the dominating source, also noise from railways, aircraft's and industrial plants have been analysed. Noise mapping in Huddinge, which recently has been published by the County Administrative Board in Stockholm (16), has been validated by actual measurements.

So far results from our exposure assessments have been evaluated for a random sample of 19 addresses located in the municipality of Huddinge. Regarding usual 5 dBA noise intervals the results fit perfectly at twelve addresses and there are small differences, 1-4 dBA, at five others. Only in two cases the results diverge more.

**Discussion** Community noise studies have traditionally considered only noise from a single specific source such as aircraft or road traffic. In recent years also noise from railway traffic has been estimated as an important source for stress induced effects. In the present study naturally road traffic noise is quite dominating. However we intend to take all form of transportation noise into account as well as analysing the importance of long-term exposure. In the analyses different concepts of summation can be used for multiple exposure as e.g. sum score, maximum score and factor score. Nevertheless the interpretation of these results have to be handled with care. It is important to point out that also a total integrated estimate of noise is not enough to get a complete picture. There are also other factors to be taken into account as contributing to noise induced stress reactions. Subjective attitudes towards the noise and activities disturbed may modify the effects of noise quite considerably. Susceptible population may include people highly annoyed by noise and persons with a family history of cardiovascular disease.

Work related conditions are also to be controlled for. Especially noise at work is a factor of crucial importance.

The use of historical individual residential façade noise assessments by help of available traffic data is a new approach, when estimating health effects due to traffic noise. The comparison of exposure calculation using the simplified model and the Nordic prediction model has hitherto indicated somewhat lower estimates when using the simplified model though the figures usually were in the same 5dBA intervals. The model will be further developed based on experiences from more sophisticated comparisons using a larger subset of addresses from our address database.

We have no reason to believe that a potential misclassification of exposure would differentiate between cases and controls in the study. Therefore, the results from the epidemiological analyses would be expected to shift toward the null. Because such nondifferential misclassification of exposure cannot be ruled out even using a more complicated exposure model, a potential increased relative risk for myocardial infarction related to traffic noise exposure would be underestimated.

According to previous epidemiological studies the availability of a quiet side, especially if it is the bedroom, and window opening habits have been considered to be of importance, when calculating noise exposure in relation to risk estimates for cardiovascular effects (8). This information is also to be controlled for in the present study,

In conclusion the SHEEP database makes extensive confounding control and high accuracy in diagnosis settling possible. The longitudinal design improves exposure calculation though problems due to that noise sensitive person move out continuously cannot be excluded.

Exposure assessments on an individual basis combined with residential positioning information raise the quality of exposure classification.

**Keywords:** noise, health effects, myocardial infarction

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