

## Health Effects of nocturnal traffic noise – sound level at subjects' home versus self-reported sleep disturbances

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### Abstract

A Berlin cohort study (N=1718), with precisely calculated nightly and daily road noise exposure, shows a relevant rise of the relative risk of medical hypertension treatment for the increasing nightly equivalent sound level at the place of residence [1]. The risk was higher for adults less than 60 years in comparison with the elderly. The effect of self-reported sleep disturbance regarding hypertension does not correspond to the effect of nightly noise exposure. The unexpected finding could be caused by the non-specific and very simple question in the Spandau Health Survey (SHS).

### Introduction

Recent epidemiological studies support the assumption that nightly traffic noise exposure plays a more fundamental role in the emergence of health disorders than noise during the daytime – particularly in relation to the cardiovascular and respiratory systems. It can be assumed that disturbed sleep patterns are impairment to health in the long run. In these terms, the usefulness of self-reported sleep disturbances is at the centre of the discussion.

### Method

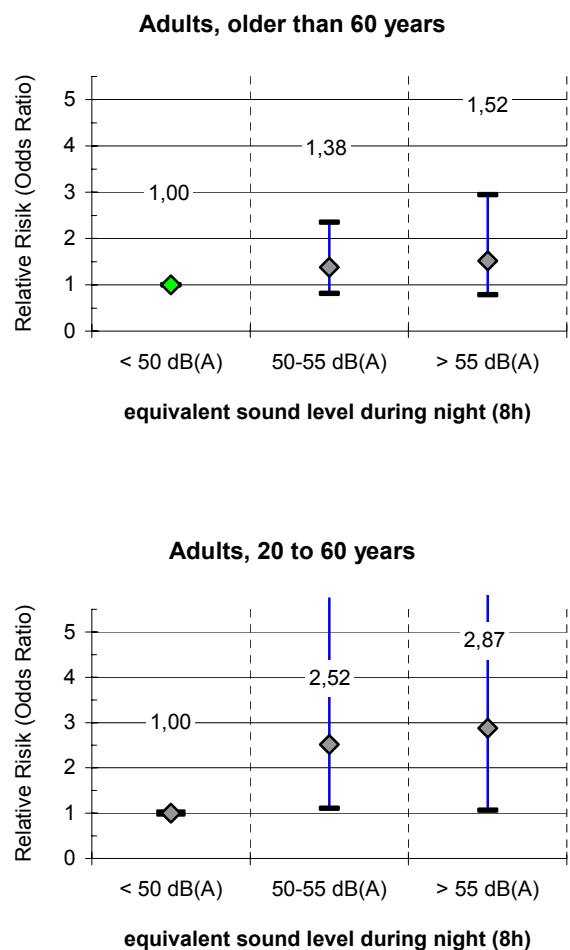
The nightly noise exposure by road traffic was gathered from a data base which was provided by the Berlin council. The data base contains noise levels separate for the day and the night calculated from traffic census data, which was checked by level measurements. With the questions "Do you suffer from sleep disturbances?" the sleep disturbance was simultaneously collected. Thus, it was possible to analyze the coincidence of health effect with the equivalent sound level as well as with the self reported sleep disturbances. The frequency of medical treatments for stress-related diseases was evaluated in the 9th cycle of the SHS (period prevalence). Logistical regressions were used for a multiple statistical analysis. As point estimators, relative risks (Odds ratios = OR) were calculated.

### Equivalent Sound Level at the Place of Residence and Hypertension

In the SHS a significant rise of the relative risk of hypertension was calculated for the increasing nightly equivalent sound level. When only test persons who normally sleep with open bedroom window were included in the analysis, the relative risk increased to 6.1 for the nightly sound exposure with more than 55 dB (A). The results confirm the thesis that the nightly noise exposure is an environmental stressor, caused directly or indirectly by disturbed sleep.

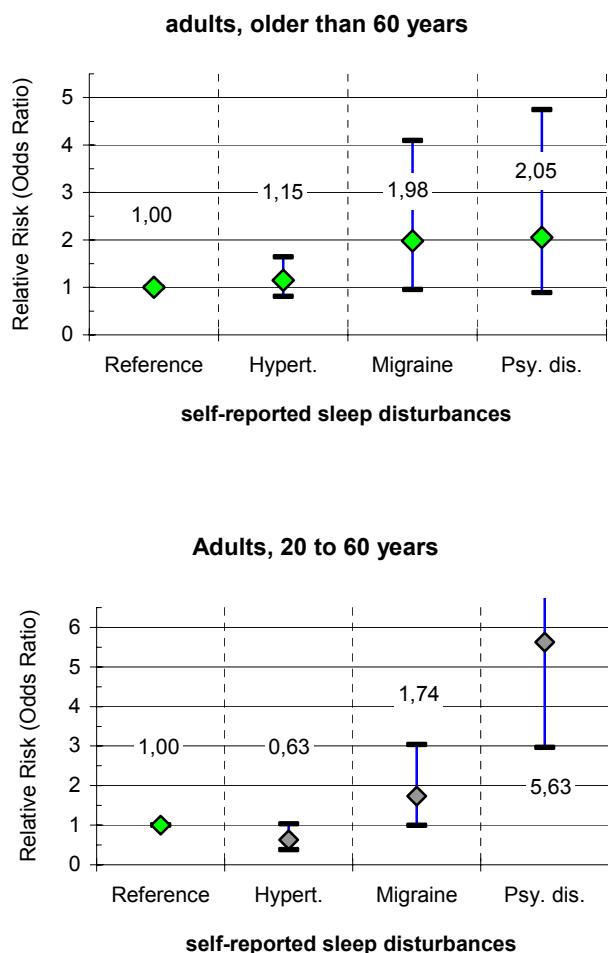
From general stress research it is well known, that the ability to cope with stress is decreased in the elderly. Therefore elderly people could be a risk group according to the nightly

noise exposure. The database of the SHS was divided into age related subgroups (cutoff point 60 years) to proof this thesis on an epidemiological level. The SHS suggests a stronger association between treatments of hypertension and the nightly noise level for adults under 60 years in comparison with the elderly (see figure 1). If occupational noise is taken into account for adults under 60 years the relative risk of a hypertension treatment rises further according to the nightly noise exposure. The self-reported occupational noise is indicated as an independent and significant risk factor (OR = 2.0; CI 1.0 – 2.8).



**Figure 1:** Statistical association between nightly road traffic noise and hypertension treatments in the 9th repetition cycle (adjusted for "age", "sex", "consumption of alcohol", "consumption of tobacco", "professional mobility", "sports", "body mass index", "social economic index", "loss of spouse", "hearing ability", "noise sensitivity" and "season of the medical examination").

The analyses of self-reported sleep disturbances shows different results (see Fig. 2). The weak relation of self-reported sleep disturbances with treatments of hypertension did not reach a statistical significance. However, a considerable rise of the relative risk in migraine and psychic disorders could be observed for adults who were under 60 years. For the elderly the relative risk in psychic disorders was only slightly increased and not longer significant.



**Figure 2:** Statistical association between self-reported sleep disturbances and hypertension treatments in the 9th repetition cycle (adjusted for "age", "sex", "consumption of alcohol", "consumption of tobacco", "professional mobility", "sports", "body mass index", "social economic index", "loss of spouse", "hearing ability", "noise sensitivity" and "season of the medical examination")

## DISCUSSION

The SHS delivers as a double-blind study safe indications that nightly traffic noise can trigger or stimulate hypertension. The medical data collection was gained by a trained doctor team of the Robert Koch-Institute (federal authority) and can be classified as reliable. The main result that a greater importance must be attached to the nightly sound exposure with respect to diseases, than to the sound exposure during the daytime, is biologically highly plausible and coincides with experimental findings to disturbed sleep

[2, 3]. The finding suggests that the elderly people are not classified as a susceptibility risk group regarding hypertension. The ability to cope with stress is decreased in elderly people but they are probably simply less stressed.

The result of self-reported sleep disturbance does not correspond to the hypothesis which connected hypertension with sleep disturbances. The unexpected result may be caused by the non-specific and very simple question. The question contains no information regarding the source of sleep disturbance, the duration and its intensity. On the other hand sleep is a highly complex restoration processes taking place under the generally unconscious (night) phase of the circadian rhythm, and self-reported sleep disturbances are only a small insight in the nightly restoration. In addition, very few correlations exist between sleep quality estimates and the measured sleep stage structure [Muzet 2002]. Long-term disturbances beneath the experience-threshold, like disturbances of the cyclic nature of sleep and the endocrine system, could be responsible for disturbed nightly restoration and therefore for the elevated risk of hypertension. Since the study delivers highly significant associations between the self-reported sleep disturbances and migraine as well as psychic disturbances it is to be assumed that for different function systems different age-related pathogenesis mechanisms exist.

## Conclusion

Hypertension represents an independent clinical picture and is a recognized risk factor for myocardial infarction and stroke. Therefore, hypertension is of great preventive medical importance. It is biologically highly plausible that the noise-induced non-rested sleep over a long period is responsible for the increased hypertension risk. To prove that thesis on an epidemiological level it is necessary to monitor the nightly noise exposure and compare noise indicators with the objective and subjective sleep quality as well as with vegetative reactions of different age groups.

## References

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